DEPARTMENT OF AGRICULTURE, VICTORIA.

FUNGUS DISEASES

OF

STONE-FRUIT TREES IN AUSTRALIA

AND THEIR

TREATMENT

(WITH 10 COLOURED PLATES AND 327 FIGURES),

BY

D. McALPINE,

Government Vegetable Pathologist.

MARCH, 1902.

Melbourne:
BY AUTHORITY: ROBT. S. BRAIN, GOVERNMENT PRINTER.

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CONTENTS.

PAGE

INTRODUCTORY ... 7

PART I.

GENERAL DESCRIPTION OF THE PRINCIPAL DISEASES AND THEIR TREATMENT.

I. Leaf-curl—

Introductory ... 13
Host-plants and parts attacked ... 13
Origin of disease ... 13
Symptoms ... 13
Curl due to peach aphis ... 13
Conditions favouring the disease ... 14
Nature of fungus causing disease ... 15
Effects and losses from disease ... 16
Geographic distribution ... 16
Treatment ... 16
References ... 20

II. Prune-rust—

Introductory ... 23
First appearance in Australia ... 23
Time of occurrence ... 23
Hosts and parts attacked ... 24
Varieties most affected ... 24
Symptoms ... 24
Effects ... 24
Fungus causing disease ... 25
Geographic distribution ... 25
Treatment ... 25
References ... 26

III. Shot-hole—

Shot-hole fungi ... 33

1. *Cercospora circumscissa*—

Introductory ... 36
Host-plants and parts attacked ... 36
Symptoms ... 36
Nature of fungus causing disease ... 36
Effects ... 37
Geographic distribution ... 37
References ... 37

2. *Clasterosporium carpophilum*—

Introductory ... 39
Host-plants and parts affected ... 39
Occurrence ... 39
Symptoms ... 39
Effects ... 40
Nature of fungus causing disease ... 40
Geographic distribution ... 41
References ... 41

3. *Phyllosticta prunicola*—

Introductory ... 41
Host-plants and parts affected ... 41
Occurrence ... 42
Symptoms ... 42
Effects ... 42
Nature of fungus causing disease ... 43
Geographic distribution ... 43
References ... 43

4. *Phyllosticta persicæ* (including *P. circumscissa*)—

General remarks ... 43

5. *Ascochyta chlorospora*—

General remarks ... 44

III. Shot-hole—*continued.*

PAGE

6. *Gnomonia circumscissa*—

General remarks 44
Life history 44

7. *Dematium pullulans*—

Introductory 45
Host-plants and parts affected 46
Symptoms 46
Nature of fungus 46
Geographical distribution 46
References 46
Treatment of "shot-hole" 46

IV. Peach Freckle—

Introductory 49
Host-plants and parts affected 49
Symptoms 49
Effects 49
Fungus causing disease 49
Geographic distribution 50
Treatment 50
References 50

V. Brown Rot—

Introductory 53
Host-plants and parts affected 53
Symptoms 53
Effects 53
Fungus causing disease 53
Geographic distribution 53
Treatment 53
References 53

VI. Bark Rot—

Introductory 57
Host-plants and parts affected 57
Effects 57
Fungus causing disease 57
Geographic distribution 57
Treatment 58

VII. Gumming or Gummosis—

Introductory 67
Symptoms 67
Causes and effects 67
Treatment 69
Opinions of growers 71
References 71
VIII. Leaf-scorch 72
IX. Split stone 72
General remarks on treatment 73

PART II.

Chart of principal fungus diseases, and treatment 77–78

TECHNICAL DESCRIPTION OF THE VARIOUS FUNGI.

Introductory 81
Fungi on fruits 83
Fungi on leaves 92
Fungi on stems and branches 111
Fungi on roots 125
Nature, habitat, and distribution of fungi 128
Host-Index 132
Explanation of plates 135
Additional Notes 161
Appendix—1. Return of stone-fruit trees, and of fruit gathered 163
" 2. Return of dried stone-fruits 163
" 3. Similar return for Mildura alone 163
" 4. Dried stone-fruit—Return for five seasons 164

The time is rapidly approaching when a farmer or gardener will as little dare to neglect the study of the physiology and pathology of plants as a surgeon dare practise without a knowledge of anatomy, or a sailor hope to become a captain without studying navigation.—H. Marshall Ward, Professor of Botany, University of Cambridge.

The day is not far distant when fungicides, and the means of applying them, will be as much a part of the equipment of a first-class farm—particularly one devoted to fruit or truck—as is the cultivator or market waggon.—Dr. B. D. Halsted, New Jersey Agricultural Experiment Station.

Under a narrow system of education and a low standard of qualifications, it may be well to fall in with the common saw—"But he is a safe man and will make no experiments," but a sound stock of principles will at once dissuade from all unsafe experiments, and give the power of meeting difficulties which to others would be insurmountable.—Rev. M. J. Berkeley, M.A., F.R.S., Mycologist and Vegetable Pathologist.

These facts are sufficient to bring out clearly the point we wished to make, namely, that spraying for plant diseases can be done at a handsome profit. In the light of our present knowledge the work must be regarded as a legitimate part of one's business. In other words, the farmers, gardeners, and fruit-growers who neglect such work at the present day are as much to blame for short crops as those who fail to perfectly manure and cultivate the soil.—Professor B. T. Galloway, Director of Office of Plant Industry, United States Department of Agriculture.

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INTRODUCTION.

In dealing with stone-fruit trees, I have confined myself to the fungus diseases of those which are commonly cultivated for commercial purposes, or those, such as the Japan plum, which are gradually being introduced. The following are the species dealt with:—

1. Almond (*Prunus amygdalus*, Stokes).
2. Apricot (*P. armeniaca*, L.).
3. Cherry (*P. cerasus*, L.).
4. Peach and its variety Nectarine (*P. persica*, Stokes).
5. Plum (*P. domestica*, L.).
6. Cherry Plum (*P. divaricata*, Ledeb.).
7. Japanese Plum (*P. triflora*, Roxb.).

There is a general feeling among growers with respect to diseases due to fungi that they are so vague and indefinite in their nature, although so destructive in their effects, that they cannot be definitely traced to their causes. Hence they fall back on all sorts of excuses for their want of knowledge. The various forces of nature are laid under contribution to explain in some hazy way the serious damage often done in spite of their best efforts to promote a healthy growth. We are told that the sun scalds, or the frost bites, a hot wind withers, or cold chills the roots, excessive drought curls the leaves, or too much moisture weakens the tissues, hence there is no help for it, but to wait for better seasons. If, however, they accustomed themselves to look for the causes of effects and the effects of causes, based upon a knowledge of plant-life, they would be able in many cases at least to discriminate between the injurious effects due to the climate, and those brought about by some definite organism. It is the object of this work to show that many of the most destructive diseases to which plants are subject arise from their invasion by minute microscopic fungi, having a definite life-history, and capable of being controlled when that history is properly understood. And the means of multiplication and spread are so boundless in these individually microscopic plants, that they often take the form of an epidemic in the host-plants on which they prey, if the conditions favorable to their development are present, for most of these fungus diseases are dependent upon a certain amount of heat and moisture in order to produce serious damage. It is the duty, therefore, of every grower who wishes to make a success of his business to familiarize himself with his unseen foes, "the pestilence that walketh in darkness," and endeavour by a right use of that knowledge to prevent as far as possible the spread of disease by sanitary precautions. Success as often depends upon preventing loss as in securing profit, and it has been well said in connexion with this very subject of plant disease that—"Competition is not likely to decrease, nor are prices likely to advance very much, and the profits must come from avoiding losses."

There are large tracts of country suitable for the growth of peaches and apricots, plums and cherries, and it is necessary that intending growers, as well as those already in the industry, should be provided with such information as will help them to make a success of it. To be forewarned is to be forearmed, and the very first appearance of disease should be promptly recognised and dealt with.

From the returns given in Appendix it will be seen that in the various kinds of stone fruits there has been an increase in the area planted and generally in the quantity of fruit gathered, comparing the two seasons of 1898–9 and 1899-1900. This has been most marked in almonds and peaches, while apricots and plums were just about the same. In cherries there was a decrease of about 5,000 lbs., but this may be accounted for from the fluctuation of the seasons.

The quantity of dried fruits annually produced is steadily advancing. Peaches and apricots during the last season have shown an increase of about 81,000 lbs. and 21,000 lbs. respectively over the preceding season, while, if we take the returns for five consecutive seasons, apricots and peaches have fully trebled in yield, and prunes have increased by about one-third.

With this increased area in planting there has arisen a corresponding necessity for careful attention to the requirements of the trees both in the way of cultivation and manuring, and the guarding against the spread of epidemic diseases. Many growers are fully alive to the danger of allowing disease to become established in the orchards, and are following out the best methods known to them for prevention. In the principal districts of the State where stone fruits are grown, there has been a marked absence of disease during the last few years, largely owing to the fact that the dry seasons which prevailed were not favorable to fungus growth. But in many instances this freedom from disease was also partly owing to the careful treatment which the trees received, the suitability to the soil and climate of the varieties planted, and the precautions taken by means of spraying to prevent fungus growth. From several districts very favorable reports have been received. Thus the hon. secretary to the Mildura Horticultural Society writes to me as follows, under date 19th June, 1900:—"For the past five years the stone fruits have been particularly free from diseases, though last year there were isolated instances of 'shot-hole' on the apricot. This exemption from disease we attribute to the fact that spraying and like precautions are regularly practised here." Then, in the Goulburn Valley, which appears to be the home of the apricot, there is also an intelligent appreciation of the necessity for keeping down disease.

One writes:—"Most growers consider it necessary to spray peaches once in winter, before buds open, for curl-leaf. I always spray at that time, and the result is, I have seen no curl-leaf for several years. It is not customary among growers to spray apricots for anything. My own conviction is that one winter's spraying with Bordeaux mixture is good for all peach trees and is quite sufficient in this district to cope with any attack of 'leaf-curl' on even those most liable to the disease." It is in a wet spring that these fungus diseases are most rampant, and then they do a considerable amount of damage.

There are only about half-a-dozen fungus diseases at present which are considered serious, viz., Leaf-curl, Shot-hole and Scab, Rust, Peach

Freckle, Brown Rot or Ripe-rot, but a number of others only require favorable conditions to spread, and therefore they must receive attention in a work dealing with the diseases of stone-fruit trees.

In the first part of the work only the more important diseases are dealt with, and illustrated by means of coloured plates, while in the second part the diseases of less common occurrence or minor importance are given, and those fungi are noted which are only known on dead or decaying parts, and called saprophytes, in contrast to those fungi which are the inciters of disease in living tissue, and are called parasites.

Part II. contains not only technical descriptions of the various fungi referred to in Part I., but likewise an account of all fungi hitherto found on stone-fruit trees in Australia.

There are 115 different species of fungi recorded here and described under the following heads :—

Fruit	20 species
Leaf	48 ,,
Stem and branch	41 ,,
Root	6 ,,

Of these, 57 or about one-half are new species, and 37 may be regarded as parasites, while the remaining 78 are saprophytes.

The plates have been drawn from nature by Mr. C. C. Brittlebank, who has faithfully represented the various diseases, so that they can always be readily recognised by the grower ; and Mr. G. H. Robinson, my assistant, has supplied the photo-micrographs, which show in a striking manner the microscopic details of several of the fungi dealt with.

March, 1902.

PART I.—GENERAL DESCRIPTION AND TREATMENT OF PRINCIPAL DISEASES.

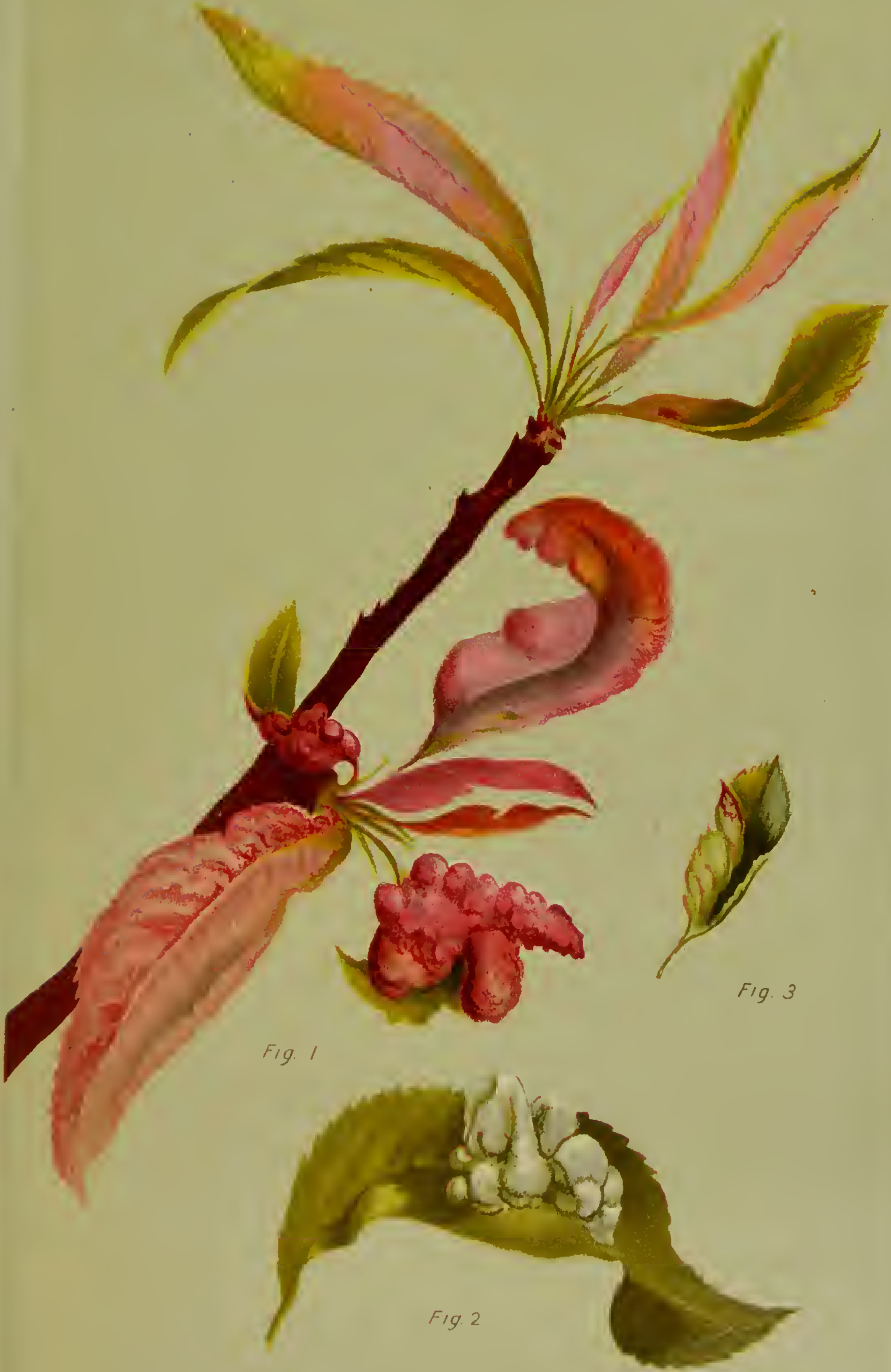
PLATE I.

LEAF-CURL (*Exoascus deformans*).

Fig.

1. Peach shoot, showing thickening, distortion, blistering, and bright colouration caused by fungus (1/10/1900).
2. Peach leaf, showing mealy covering on upper surface formed by spores (23/11/1900).
3. Young peach leaf beginning to curl (19/9/1900).

Plate 1.



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1. PEACH LEAF-CURL.

(*Exoascus deformans.* Fckl.)

The name of "curl" or "blister" has been given to this disease from the appearance of the affected leaves. The first formed leaves become thickened, and puckered, and discoloured, and soon fall away; then another set of leaves are produced, but too late to fully mature the fruit. The disease may be detected as soon as the leaf-buds have slightly opened, by the puckering of the surface and the bright coloration of the young leaves. As the leaves approach maturity the distortion becomes more marked, so that often the entire blade becomes corrugated and curled. The colour, too, is heightened, and the diseased parts have usually a bright ruddy appearance, often tinged with green, but every trace of green may ultimately disappear. Then the surface becomes a dirty grey, as if covered with flour, showing that the final stage of the fungus has been reached, and that the fructification is being formed, spores being produced to disseminate the disease. Soon the vitality of the leaf is exhausted; it dries up and falls away, carrying a load of spores on its surface to perpetuate the disease.

Host-plants and Parts Attacked.—It occurs on the leaves and young shoots of the peach in Australia, and all the symptoms of it, without the production of spores, have been found on the fruit of the nectarine. It is believed that it is almost wholly confined to the peach or its derivatives, such as the nectarine and peach-almond, for its occurrence on the almond, cherry, and plum, has been so rare, that these examples may be regarded as exceptional. The distribution of the fungus is wide-spread, its presence having been reported from nearly every part where the peach is cultivated.

Origin of Disease.—The study of origins is always interesting, although in many cases it is difficult to arrive at definite conclusions, and the country where peach leaf-curl first originated is not positively known. China is supposed to be the home of the peach, and it is known that seedling peaches are peculiarly susceptible to this disease, so that it is reasonable to suppose that the disease came with the peach from its native home. As far as Australia is concerned, the late Mr. Neilson stated that the disease has been known in Victoria since 1856, and, therefore, its importation from Europe is not at all unlikely.

Symptoms.—These are so well-marked as scarcely to require description, and the principal features have been outlined above. The diseased leaves are often at first of a pale yellowish-green, or they may have a rosy tint. Then the swollen portion becomes covered with a delicate white bloom which has a velvety appearance under a magnifying glass. This appearance is due to the fructification of the fungus, which bursts through the cuticle of the leaf and comes to the surface in order that the spores may be readily and rapidly diffused. Not only are the leaves, including blade and stalk, affected, but the tips of the young shoots are discoloured, distorted, and swollen, since the mycelium of the fungus is, to a certain extent, perennial in the branches, although it only very slightly infects the leaf-buds. Accompanying this disease, as well as others of the peach, there is often copious gumming.

Curl due to Peach Aphis.—There is a somewhat similar appearance produced by the peach aphis, which must not be confounded with this, since the treatment is entirely different. The green or brown insects will be present in the one case but absent in the other, and even in cases where the two diseases occur together, the symptoms are distinct. In the case of the fungus the young shoots become swollen; the leaves are decidedly thicker and generally larger than the healthy ones; they usually assume a red tint, and finally become an ashy-grey, due to the dusting with the innumerable spores. Such leaves fall away early.

In the case of the aphis, the curled portions are not so perceptibly thickened, not so highly coloured, and not dusted over with spores. The leaves do not fall away so readily, and on their under surfaces either the aphides themselves are found or their remains. For description and drawings, see French's *Handbook of the Destructive Insects of Victoria*, Part II. (1893).

Conditions favouring the Disease.—This disease, like so many others, is dependent on climatic conditions for its spread, and these conditions are often regarded as the cause, so that we hear of it being due to chilling at the roots, deficient root action, and so on. If the season allows the leaves to attain their full development without a check then the disease does not occur, whereas, if growth is checked by sudden changes, then the disease flourishes. It is said that a cool moist spring favours the disease, and it is well known that a sudden rise of temperature or drying winds check it at once; but such conditions affect the development of the fungus as well as that of the leaves. It is reasonable to suppose that it is those weather conditions which prevail at the period of germination that control the number of infections, but the after-effects and virulence of the disease will depend upon the amount of rain falling in the spring. A wet spring induces too vigorous a growth, hence the tissues are so soft that the mycelium of the fungus readily spreads there, while in a dry season its growth is checked.

The mistake is often made of confounding the accompanying climatic conditions with the determining cause of the disease and then, of course, preventive treatment is out of the question, since we cannot control the weather. The late Mr. Neilson, curator of the Horticultural Gardens, Burnley, said at a conference of Australasian fruit-growers, held at Wellington, May, 1896—"One gentlman had recommended spraying for peach-curl. He had found, from 30 years' experience, that spraying for peach-curl was worthless. It was the difference in the temperature above and the temperature under the soil—which was so unequal—which caused some stagnation in the sap, and that caused the curl. For the last 30 years he had tried everything for the peach-curl and nothing had been found effectual, unless he could get his Department to put a hot-water pipe under the tree; that would cure it." And yet when the true nature of the disease is understood, so far from spraying being worthless it is found to be a certain preventive for the disease when done properly and at the right time, as shown even as early as 1891, by Mr. Robin, of South Australia. The cold and wet spring of the past season favoured the disease considerably, and, in some districts, the peach leaves were one mass of bright colours owing to the fungus. The coloration of the leaves was observed even when they were just bursting from the leaf-buds. These conditions were so favorable, because they rendered the tree more susceptible and the development of the fungus more certain and luxuriant. The tissues of the peach became saturated and softened with the moisture, and allowed ready access to the germ-tubes of the spores.

Nevertheless, it is the fungus which works the actual mischief, and this point is rightly emphasized by Pierce, in a work afterwards referred to, where he says—"However, too much stress can not be placed upon the fact that the fungus alone is responsible for the injury to the tree. Without the parasite not a leaf would curl, nor a peach fall on account of this malady; in fact, no such disease would exist. It is fortunate that the direct cause of peach leaf-curl is a parasitic fungus rather than unfavorable atmospheric conditions, for the latter could not be controlled, while the control of the fungus has been found practicable, simple, and inexpensive."

Nature of Fungus causing Disease.—While certain conditions predispose to the disease, there is always a distinct fungus associated with it. The disease, in fact, is caused by *Exoascus deformans*, Fckl., the generic name indicating that the asci or bags containing the spores are produced naked and not enclosed in a case, while the specific name expresses the deformity caused by the fungus. The mycelium or filaments of the fungus ramify among the cells of the leaf, absorbing the nourishment stored up there, and the plant endeavours to meet the increased demand made upon its resources by multiplying the cells and causing an overgrowth of the tissues, hence the blistering distortion and thickening of the leaf.

About the beginning of November the spores are formed in the bags exposed on the surface of the leaf and are readily spread by the wind. Not only are the asci or bags containing the spores arranged upright and closely crowded in order to produce the greatest possible number in a given space, but the eight spores (which is the usual number produced in asci among fungi generally) bud either within the ascus or outside of it, and produce numerous minute secondary spores, so that each bag is generally filled with them.

The mature spores are then set free and form a mealy covering on the upper surface of the leaf, the particles of which are so minute and light that they are readily carried by the wind. The germination of the spores has been observed by Pierce to take place in two ways—by means of budding either before or after the escape of the spores from the ascus, or by means of germ-tubes which probably infect the host plant directly.

But just here there is a gap in our knowledge of the future history of the spore, for the direct infection of the leaf by means of spores has not been observed. Does the spore germinate at once and produce the disease again immediately; or does it winter somewhere on the tree, leaf, or ground, and germinate next spring? Since the second crop of leaves are not usually infected, it would seem that the spores do not germinate immediately, but that they winter somewhere, and when the warm days of spring cause the buds to open, then they too burst into life and infect the young and tender foliage. Two modes of infection, however, are said to exist—1st, by means of spores (already considered), and, 2nd, by means of a perennial mycelium which is said to pass the winter in the youngest portions of the one-year-old branches. Spring infection of the peach foliage was supposed to be largely due to the extension of this internal mycelium into the new shoots and leaves from the shoots of the previous summer, and thus the fungus has at least two chances of reproducing itself, either from the germination of the spore or from the extension of the perennial mycelium. But Pierce has definitely proved that the perennial mycelium is not responsible for more than a very small percentage of the infections in the spring ; for experiments have demonstrated that by a single thorough application of a suitable spray as high as 98 per cent. of infections may be prevented. If the extension of the mycelium largely caused the disease, as previously supposed, it is not likely that a spray would reach the interior and check it. The spray is efficacious, because most of the infections are due to spores, and not to a perennial mycelium which is probably a means of perpetuating the fungus should adverse conditions prevent the germination of the spores.

It is evident that the period of infection will determine the best time to apply preventive treatment, as well as explain the effect of weather conditions on the development of the fungus. The conditions prevailing at the time of germination will probably settle the greater or less prevalence of the fungus and its ability to infect the buds or leaves. If the spores germinate in the spring, as they probably do, then cool and moist weather would be in their favour, the tissues of the leaf being soft and readily allowing the germ-tubes of the spores to enter.

Effects and Losses from Disease.—This is a disease which is very destructive and rapidly spreads, principally by means of the spores produced on the surface of the leaves. In a bad season a tree may be completely divested of its leaves, and although a second crop of leaves may appear later on, unaffected by disease, still they cannot make up for the loss. The season's crop is often practically a failure, and the wood for next year is imperfectly matured. While the tree survives the loss of its leaves, still many shoots die, and the vitality of the whole is weakened. It is no uncommon experience in some districts to lose practically the whole crop on such varieties as Early Rivers, which, besides being very susceptible, ripen their fruit so early that the tree has no time to recuperate. The disease is cumulative in its effects, and, continued from year to year without check, it gradually undermines the constitution of the tree and causes its premature decay and death.

It is difficult to estimate the annual loss caused by this disease, and it is greater than growers think, because a great deal of the injury really due to it is attributed to other causes. In the United States it has been estimated from reliable data that the entire annual loss is not less than £600,000.

Geographic Distribution.—It exists in all the continents, and indeed wherever peaches are grown. In the United States and Canada, as well as in South America, it causes considerable loss. In Europe it is common, especially in France, Germany, Austria, Italy, Switzerland, and Denmark ; and in Great Britain it had been recorded as early as 1821. In Africa it exists in the peach-growing countries, such as Cape Colony, Natal, and Algeria. In Asia it is reported from China and Japan, and is a serious disease in the Australian States, as well as in New Zealand.

Treatment.—Just before sending this work to the press I received, through the courtesy of the author, Newton B. Pierce, in charge of Pacific Coast Laboratory, Santa Ana, California, a most exhaustive work on "Peach Leaf-curl : Its Nature and Treatment," consisting of 204 pages, with 30 plates and 10 figures. The information contained in it is so up to date, and the results of experiments given are so conclusive as to the best methods of treatment, including what has been done in most parts of the world, even in Victoria, that I have largely availed myself of its contents. The key-note of the work is sounded in page 1, where it is stated—"The obscure views held by many growers in the past upon the true nature of peach leaf-curl, and the total lack of preventive measures up to a recent date, make it desirable to thoroughly consider the subject at this time, and to record the detailed work upon which the conclusions reached are based. These conclusions are that peach leaf-curl may be prevented with an ease, certainty, and cheapness rarely attained in the treatment of any serious disease of plants, and that there is no longer a necessity for the losses annually sustained from it in the United States."

As early as 1896, the Department of Agriculture, Victoria, issued a "Guide to Growers, No. 27," in which drawings and description of the disease are given, together with the necessary treatment. That treatment consists in spraying with Bordeaux mixture, for although a number of substances have been tried with more or less success, that is the cheapest, most easily applied, and most satisfactory in its results.

Among other substances used, a spraying with lime, sulphur, and salt in winter, originally used as a sheep-dip in Australia, and known as the "Victoria lime-and-sulphur-dip," was found to be an effectual remedy for this disease. It may also be noted here that, as early as 1891, the copper treatment for the disease was clearly demonstrated in South Australia, and published in the *South Australian Register* of 30th March, 1892.

The following measures are recommended for the treatment of peach leaf-curl:—

1. Fallen and diseased leaves should, as far as practicable, be collected and burnt.

The advantage of doing so is evident, for the reduction of the number of spore-bearing leaves will lessen the supply of spores for next season.

If it is impracticable to collect the diseased leaves, they certainly should not be gathered around the butts of the trees to form a mulch, as I have seen done in some instances.

2. Diseased branches should be cut back beyond the point of origin of the diseased leaves and burnt.

The object of thus pruning back is to get rid of the perennial mycelium in the affected branches, for although such swollen branches containing the mycelium are only supposed to be responsible for 2 to 3 per cent. of the injury, still they weaken the tree, and are better out of the way. But it is well known that the disease will not be prevented by merely cutting back the branches, nor is it practicable to remove the diseased leaves early, before the spores are produced, so that it is necessary to spray to destroy the fungus.

3. Spray with Bordeaux mixture just before the opening of the blossoms.

In the United States Professor Taft has used successfully as a spray a solution of 1 lb. of bluestone in 25 gallons of water, applied from four to six weeks before the buds open. The ease with which this spray is washed off by rain is, however, a serious drawback to its general use.

Treatment of Nursery Stock.—This important subject has engaged the attention of Pierce, who thinks there is little doubt that leaf-curl has been spread throughout the world by means of nursery trees. If the perennial mycelium was in the buds, and produced infection as supposed, then nurserymen would be disseminating disease through the budded seedlings, but since only a small percentage of it can be produced in this way, and up to 98 per cent. from spores upon the tree, probably resting within or upon the bud-scales, then spraying would be beneficial.

He makes the following recommendations :—

1. Spray the trees from which buds are to be selected with strong Bordeaux mixture.

2. Where last year's branches are removed, as a whole, the bud-bearing shoots should be thoroughly dipped once or twice in Bordeaux mixture,

3. After the nursery trees are budded, they should be sprayed thoroughly with Bordeaux mixture.

Experiments were carried out by a large firm of nurserymen, in which peach trees one year old were sprayed twice in April (early spring) with a mixture consisting of 5 lbs. copper sulphate, 10 lbs. lime, and 45 gallons water. The results were so good that they repeated the treatment next year, twice in the month of March.

The treated trees were stated to be nice and straight, and made good growth, there being no curl, and the growth continued throughout the season ; while the untreated trees curled so badly that many were crooked and stunted, and even worthless, and about a foot shorter than the sprayed trees.

Some growers in a dry district, such as Ardmona, have given their experience of this disease.

Mr. Lenne informs me that he can prevent both "Leaf-curl" and "Rust" in his peaches by spraying in the latter part of winter, before the buds start, with Bordeaux mixture, at the rate of 1 lb. sulphate of copper and 1 lb. lime to 10 gallons of water.

Mr. Ratcliffe considers that peaches worked on almond stocks are much more liable to "curl" than those worked on their own roots. He is satisfied that Bordeaux mixture is a preventive, for he has not found a single curled leaf in his own orchard, while in neighbouring orchards where spraying is not practised, there has been a little, notwithstanding the dry seasons.

Select those varieties known to be least susceptible to the disease, if otherwise suitable for the district. As our present knowledge of such varieties is very limited, there is not much practical advantage in the advice, only it may attract attention to those constitutional peculiarities which enable some varieties to ward off disease better than others. The general consensus of opinion in the Ardmona district is that Early Rivers and Lady Palmerston are the two varieties of peach most subject to leaf-curl, the former going out of cultivation there partly on this account, but the latter responds well to spraying.

To sum up, the treatment will essentially consist in a winter spraying of the trees with Bordeaux mixture, from one to three weeks before the opening of the blossom-buds. In wet localities a second winter spraying is recommended, and a proportional increase of lime and bluestone in the mixture in order to make it adhere better. Spraying should be done each season, as treatment one year does not afford immunity for the next. Spraying should be thoroughly done, in order to cover every portion of the tree, and for this purpose cyclone nozzles, with lateral or diagonal discharge, are the best. The best time to spray is when the weather is calm and dry, and during the day when dew or frost will not interfere with the adhesion of the mixture.

Mr. A. B. Robin, of Nuriootpa, South Australia, has kindly favoured me with a short account of spraying experiments made as early as 1891 for peach leaf-curl. The copper treatment for curl was first advocated in Australia by the late Mr. Frazer S. Crawford, and the first to practically prove its efficacy was Mr. Robin, in 1891.

He writes :—"I applied a solution of copper sulphate 1oz. per gallon to every alternate tree in a row of young peach trees, just as the buds were swelling. The result of this experiment was published by Mr. Crawford in the *Garden and Field*, and the marked contrast between the trees so treated and the rest which were badly affected, induced me to continue planting peach trees, although this locality is very favorable to the disease.

The following year a committee consisting of three growers, including myself, was appointed by the Agricultural Bureau to carry out a series of experiments in spraying for the following diseases which, at that time, were devastating the orchards, viz., *Fusicladium*, "Shot-hole" and leaf-curl. Bordeaux mixture (6 lbs. copper sulphate and 4 lbs. lime to 22 gallons water) was found quite effective in preventing curl, but it was not perfectly successful with regard to the other diseases, although causing a great improvement. The same year I sprayed a great portion of my own orchard. Spraying for curl and the other two diseases in a few years became quite general in this district, and with regard to peach-curl the experience of eight or nine years has shown that, except upon a few varieties, Bordeaux mixture, at the rate of 1 lb. each of bluestone and lime to 7 gallons of water, is a safe and sure preventive of leaf-curl if applied just before or during the flowering period. For the Elberta variety, which seems to be particularly susceptible, I would recommend a stronger winter solution or else a subsequent spraying."

The following sorts seem to be most resistant :—Salway, Early Crawford, Muir, Briggs' Red May. A cold wet spring is most favorable to the disease. In Mr. Robins' orchard a peach tree was sprayed on one side with the Bordeaux mixture and the foliage was clean and healthy on this side, while it was curled on the unsprayed side. "Here again," remarked the reporter, "was absolutely conclusive evidence of the preventive effect of spraying for leaf-curl."

Peach Varieties in Relation to Curl.—In the United States particularly, attention has been paid to this phase of the question, but while it is well known that certain varieties are less susceptible than others, this is a variable quantity, so that varieties may be resistant in one locality and succumb in another. Still, in a given district, where the soil and climate, heat and moisture, are more or less constant, there are varieties more hardy and less susceptible than others, and the grower would be guided in his selection by this knowledge.

Not much information of this sort is available in Australia as yet, but in America an attempt has been made to obtain the opinions of growers on various points. The majority consider seedlings more liable to curl than budded trees, and also that there is no difference in this respect between early and late blooming varieties. The finest varieties seem to have a delicacy of constitution which renders them peculiarly susceptible, and it is noticeable that both in Australia and America the Elberta variety is very susceptible.

If we compare the relative susceptibilities of varieties already mentioned, as given for the United States in tables carefully compiled by Newton B. Pierce, the results are as follows:—

Variety.	Australia.	United States.
Briggs' Red May ...	Resistant ...	Susceptible
Early Crawford ...	Resistant ...	Very susceptible
Early Rivers ...	Very susceptible	Very susceptible
Elberta	Very susceptible	Very susceptible
Lady Palmerston ...	Very susceptible	Susceptible
Salway	Resistant ...	Very susceptible

But the successful treatment of this disease enables superior varieties to be grown with profit, although subject to curl, and as Mr. Robin practically showed, they may be planted even in localities favorable to the disease (Pls. I., XXII., and LIII.).

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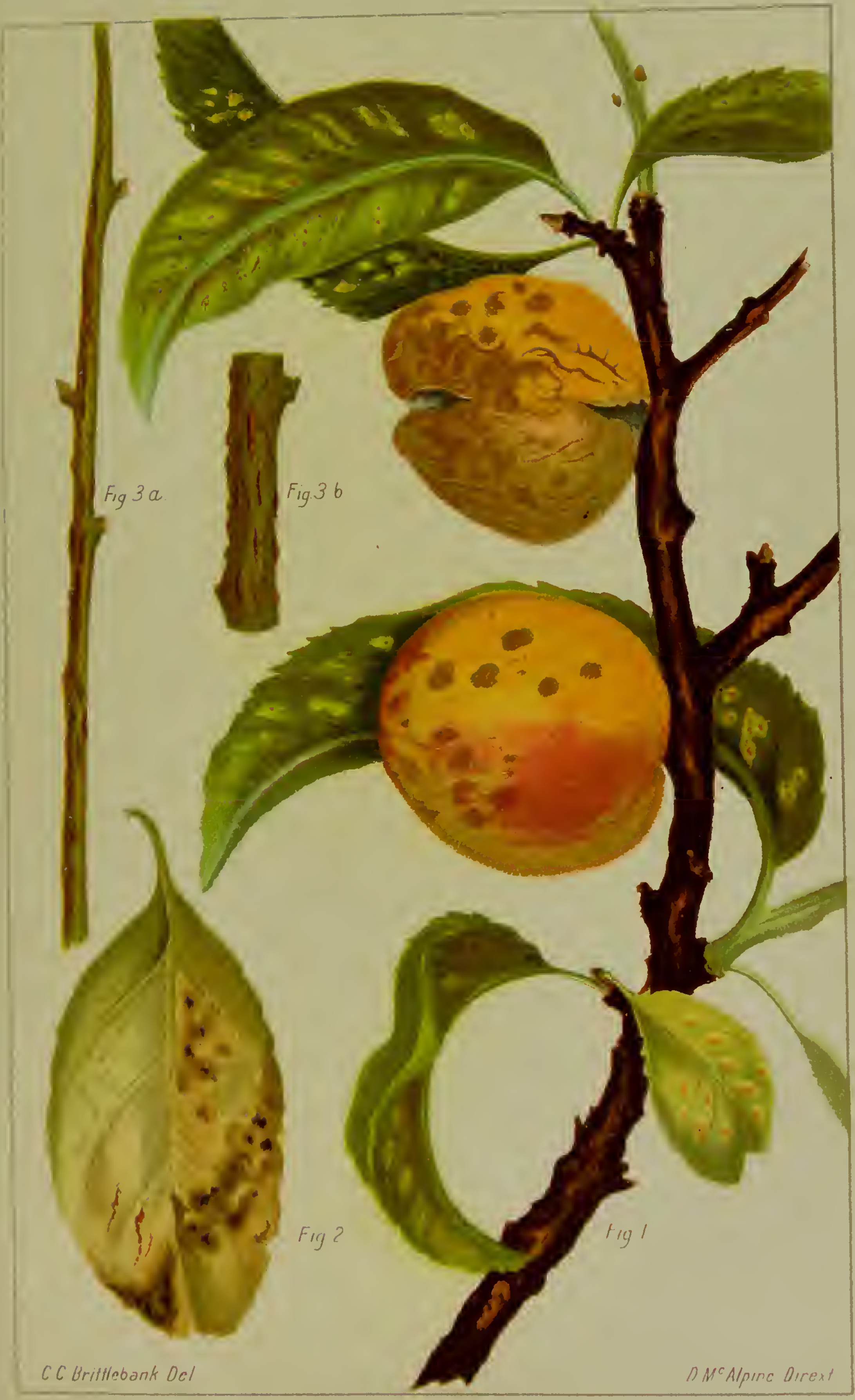
PLATE II.

Prune Rust (*Puccinia pruni*).

Fig.

1. Fruiting shoot of Lady Palmerston peach with rust on leaves and fruit (22/2/1900).
2. Under surface of plum leaf showing blister-like pustules of rust towards left-hand corner (12/4/01).
3. *a* and *b*. Twig covered with rust pustules (*b* enlarged).

Plate II



C C Brittlebank Del

D McAlpine Dirext

2.—PRUNE RUST.

(*Puccinia pruni.* Pers.)

This rust is of great economic importance, since it attacks such valuable fruit-trees as the peach and nectarine, plum and apricot, cherry and almond, causing them prematurely to shed their leaves, and as a consequence either to bear no fruit, or only small quantities of an inferior kind. As the peach-tree, for instance, forms its fruit on the previous season's wood, it is evident that the succeeding crop will be affected as well, hence the necessity for attending to the earliest signs of the fungus. It is known wherever stone-fruit trees are cultivated, and yet it is sometimes confounded with very different things. It is very commonly called "Peach Yellows" in these States, on account of the yellow blotches or freckles on the upper surface of the leaf, but it has no connexion with the dreaded American disease which is now believed to be due to bacteria. I have even known its effects to be mistaken for the tints of autumn, and this seemed all the more plausible, as it is usually associated with the shedding of the leaves; but it will be observed that the leaves begin to fall towards the base of the branch, and a tuft is often left at the top. The fungus thrives well in our genial climate, and in favorable seasons is very prevalent. It does not confine itself to the leaf, but even attacks the stem and branches at least of young seedlings, and is now becoming a serious enemy to the peach fruit itself. Pierce notices that it infests the tender branches of the peach in the United States. On account of its prevalence and destructive nature, it will be somewhat fully treated here.

First appearance in Australia.—It is both interesting and useful to trace the first appearance of any disease in our midst. Since 1891, when my first report was made upon it, this disease of the peach and allied trees has been constantly under observation. In certain fruit-growing districts it was only observed during season 1890–91 for the first time, but the late Mr. Neilson, of the Royal Agricultural Gardens, Burnley, informed me that the disease was observed there about 1887, and that he had heard of it in the Ferntree Gully district about 1885 or 1886. In the season of 1887–88 it was also reported from New South Wales, and in season 1889–90 it affected a large number of peach trees there.

Mr. Molineux, F.L.S., Secretary to the Agricultural Bureau of South Australia, informed me that the first public reference to this disease was made by the late Frazer Crawford during May, 1890, in the *Garden and Field*, as having been observed for the first time on peach trees, and he had little doubt that it occurred some time before, but on plum trees.

It is also present in Tasmania, and Mr. Tryon's discovery of it in Queensland in February, 1886, is undoubtedly the first definite record of its appearance in Australia.

Time of Occurrence.—The time of its appearance varies in different seasons, and the later it is the less damage it does. Generally the spores are plentifully produced about the beginning of the year, and the leaves have usually all dropped off by April. The disease also seems to be intermittent in its character according to the prevailing weather, and while moisture in the early spring or in the middle of summer encourages the fungus, other conditions, such as accompanying heat or cold, or the amount of moisture in the air, likewise influence it.

Hosts and parts attacked.—It has been found on all the stone-fruit trees grown here with the exception of the cherry. It is most prevalent on the plum and peach, and not so common as yet on the apricot and almond. In other countries it is found on the cherry as well.

It is generally known as a leaf-rust, because it is on the under surface and occasionally on the upper surface of the leaves that it is usually found, but I have met with it on the fruit and branches as well. J. G. O. Tepper, F.L.S., of South Australia, sent me an apricot with rust upon it for determination, and he was rather surprised to find that what had hitherto been considered a leaf-rust should also become a fruit-rust. In February of both 1900 and 1901 I received specimens of Lady Palmerston peach, from Panton Hill, Victoria, badly affected with the rust. The fruit had somewhat dark depressed spots, with minute clusters of uredospores badly disfiguring it, and in some instances the fruit was split. Even the stem of a young seedling peach was badly attacked by the rust, showing that our climate is particularly favorable for its development and spread, and it also points to the grave danger of allowing fungus pests to run rampant, for they may attack quite a variety of fruits here to which they were formerly strangers, as well as different organs of the plant.

Varieties most affected.—In the Royal Horticultural Gardens, Burnley, where so many different varieties are grown, I was able, with the assistance of the late Mr. Neilson, to select some of those most affected with the rust. Kerr's Slipstone, Royal George, and Crimson George are very liable among peaches, and Darwin and Dante among nectarines. Seedling peaches are also badly attacked. Plums, such as Late Harvey and Imperial Ottoman, were very bad, and it was noticeable that all those provided with thorns, such as the French Cherry Plum, seemed to enjoy comparative immunity from the disease.

Symptoms.—The upper surface of the leaves becomes speckled with yellowish patches, which often run into each other, and on the under surface there are corresponding powdery patches. These are of an orange-red or rusty-brown colour, and the pustules burst through the raised epidermis as if it were a little bag. The spores are sometimes so numerous as to cover the under surface of the leaves with what looks like a brown coating of mud.

The disease seems to begin on the lower leaves of the branch, and to travel upwards, so that the leaves begin falling away at the lower end, while those at the tip remain attached.

Effects.—Since the peach tree, for instance, bears its fruit on wood formed the previous season, it is evident that anything which tends to make this poor in character will injuriously affect next season's crop. The premature shedding of the leaves, and the consequent weakness induced by the loss of such important organs, has a decidedly injurious influence upon the tree, not to speak of the injury caused by the leaves while attacked being unable to fulfil their ordinary functions, and the nourishment being appropriated by the fungus which ought to go to the upbuilding of the tree itself. The fungus, being on the under surface, likewise interferes with the healthy action of the stomata, and supplies of food and air necessary for healthy growth are restricted. When it occurs on the young stems and branches as well, the vigour of the tree is rapidly impaired, and when it attacks the fruit the development and proper ripening is interfered with. This is a disease which has been regarded too lightly by the grower, and has been left too long unchecked, for it gradually weakens the constitution of the tree and may ultimately cause its death.

Fungus Causing Disease.—All the rusts are parasites, and the fungus causing this disease is *Puccinia pruni*. It occurs on the under surface of the leaves, where it is most uniformly moist, in the form of small brown pustules. The delicate filaments of the fungus ramify in the tissues of the leaf, nourished at the expense of the plant, and when they have exhausted the supply of food proceed to form the reproductive bodies. The pustules on the under surface are caused by the swelling spores, and soon the epidermis is ruptured, so that the spores are set free.

The future history of the fungus is bound up in these spores. As in the case of rust in wheat and many other rusts, there are two kinds of spores, one called the summer spore, or uredospore, because it is produced during the summer, when food is plentiful, and is adapted for the rapid multiplication of the species ; the other called the winter spore, or teleutospore, because it rests during the winter and tides the fungus over the season when the trees are bare, and is ready to germinate when the leaves reappear. Clusters of spores occur on the young shoots before growth begins in the spring, showing that spores may not only be dusted over the tree from the leaves, but that they may winter on the branches after being produced there.

In April the leaves of plum trees are generally dusted all over with the dark-brown teleutospores, and only an occasional uredospore could be found. The falling leaves carry these spores to the ground, and there they remain during the winter, ready to germinate when favorable conditions arise.

It is remarkable that the teleutospores are comparatively rare on the apricot and peach, and less so on the almond, but the plum seems to have some peculiarity in its constitution which stimulates the formation of the resting spores.

Geographical Distribution.—This disease has a very wide distribution, probably co-extensive with the cultivation of stone-fruit trees. It occurs in Britain, France, Germany, Italy, Austria, Belgium, Switzerland, North America, Canary Islands, India, Cape Colony, and Australia. In Australia it has been found in Victoria, New South Wales, Queensland, South Australia, and Tasmania.

Treatment.—Since the fungus occurs on the stem and fruit, as well as on the leaf, it will be necessary to remove and destroy all affected parts, so that no decaying litter left about the orchard may harbour the winter spores.

In addition to all those measures which are necessary for the proper development and healthy growth of the tree, the following should be employed :—

1. Remove and burn all affected parts, in order that the spores for next season may be destroyed as far as possible.

2. Spray with Bordeaux mixture, so that not only the spores may be destroyed or rendered harmless, but that the tree may be able to

resist infection. Seeing that the fungus may attack all the parts of the tree above ground, the spraying should be thoroughly carried out at various times.

1st. Just before the buds burst, for at this time the spores are preparing to germinate, and then they are most easily acted on.

2nd. When the leaves are expanding, and especially on the under surface, by means of an oblique spray where the rust-pustules will appear.

The number of sprayings will depend upon the season, and it may be that after a thorough winter spraying to clean the tree, as in peach leaf-curl, no more will be required. (Pls. II., Pl. III., Fig. 1, Pl. VIII., Fig. 1, XXI., and LII.)

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PLATE III.

Shot-Hole (*Various Fungi*).

Fig.

1. Plum leaf showing shot-hole.
2. Apricot leaf showing shot-hole.
3. Peach leaf showing shot-hole.

Plate III

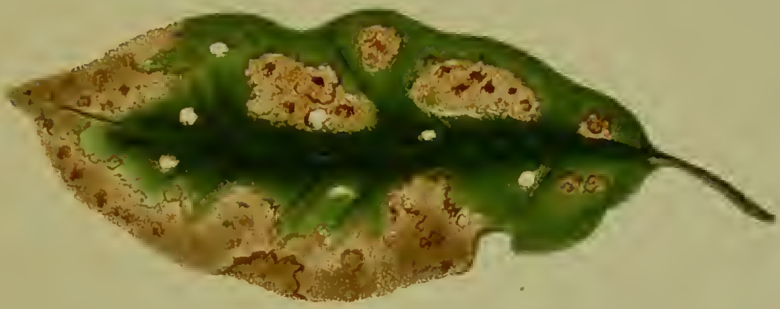

Fig. 1.

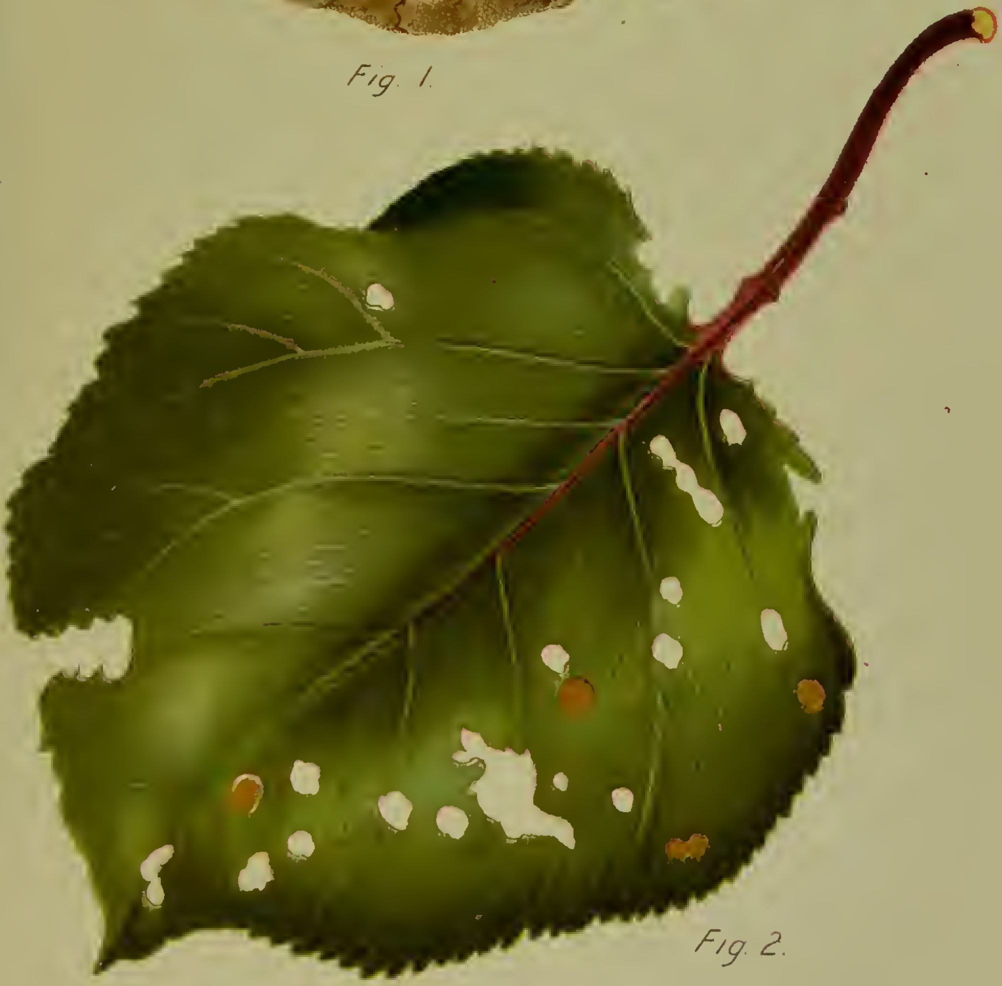

Fig. 2.

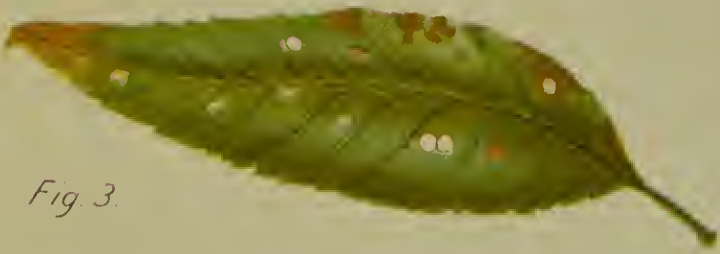

Fig. 3.

PLATE IV.

Shot-Hole—*continued.*

Fig.

1. Plum-leaf riddled with holes and decaying at margin.
2. Young shoot of apricot, showing early formation of "shot-holes" (ten days after bursting of bud).
3. Young shoot of peach, showing "shot-hole" of leaf.
4. Portion of upper surface of peach-leaf, showing brown-spot with perithecia of *Phyllostica prunicola* on surface.
5. Small portion of same magnified, showing superficial, globose, shining perithecia.

Plate IV.

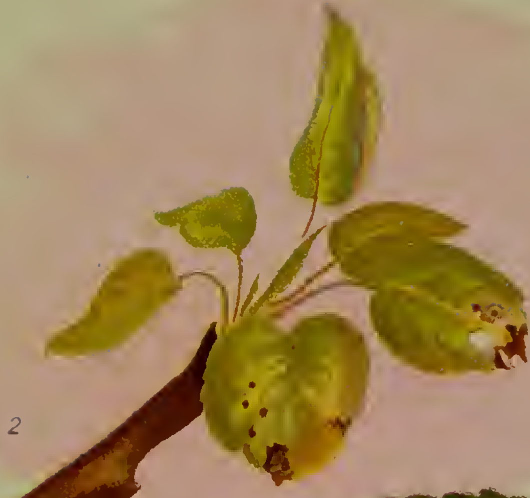

Fig. 2

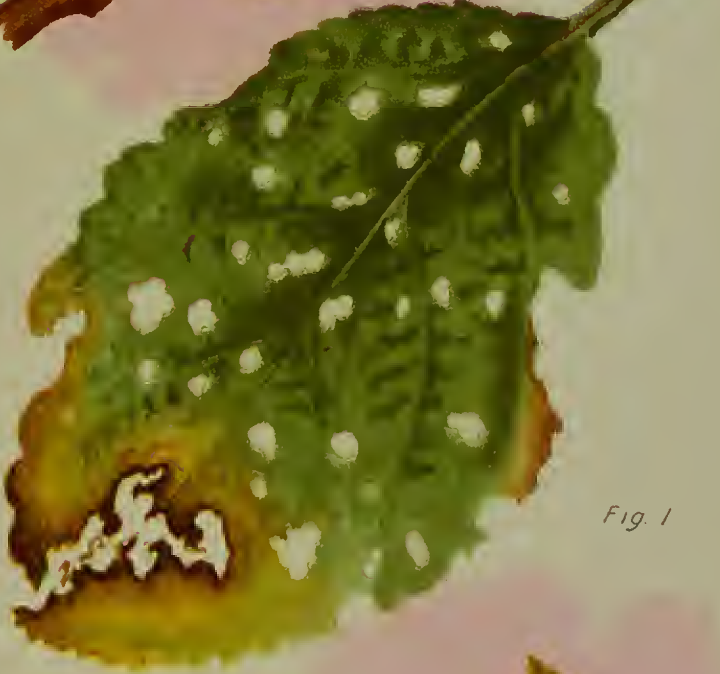

Fig. 1

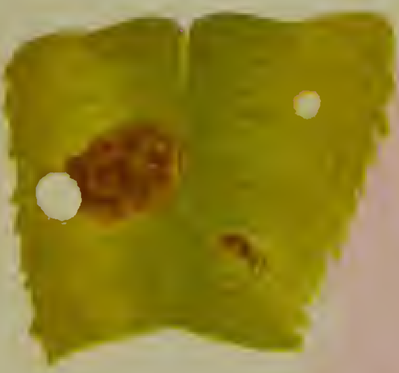

Fig 4

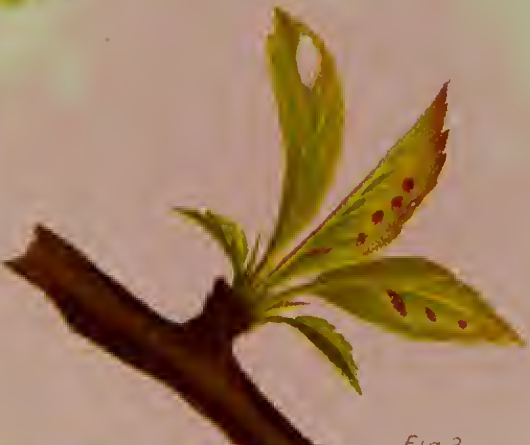

Fig. 3

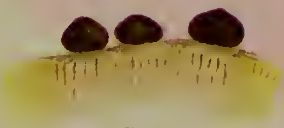

Fig 5

C.C. Brittlebank P.X

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PLATE V.

"SHOT-HOLE" AND SCAB OF APRICOT.

Fig.

1. Fruiting branch, showing "shot-hole" of leaves and "scab" of fruit caused by same fungus.
2. Young fruit commencing to "scab" (11/11/1900).

Plate V.

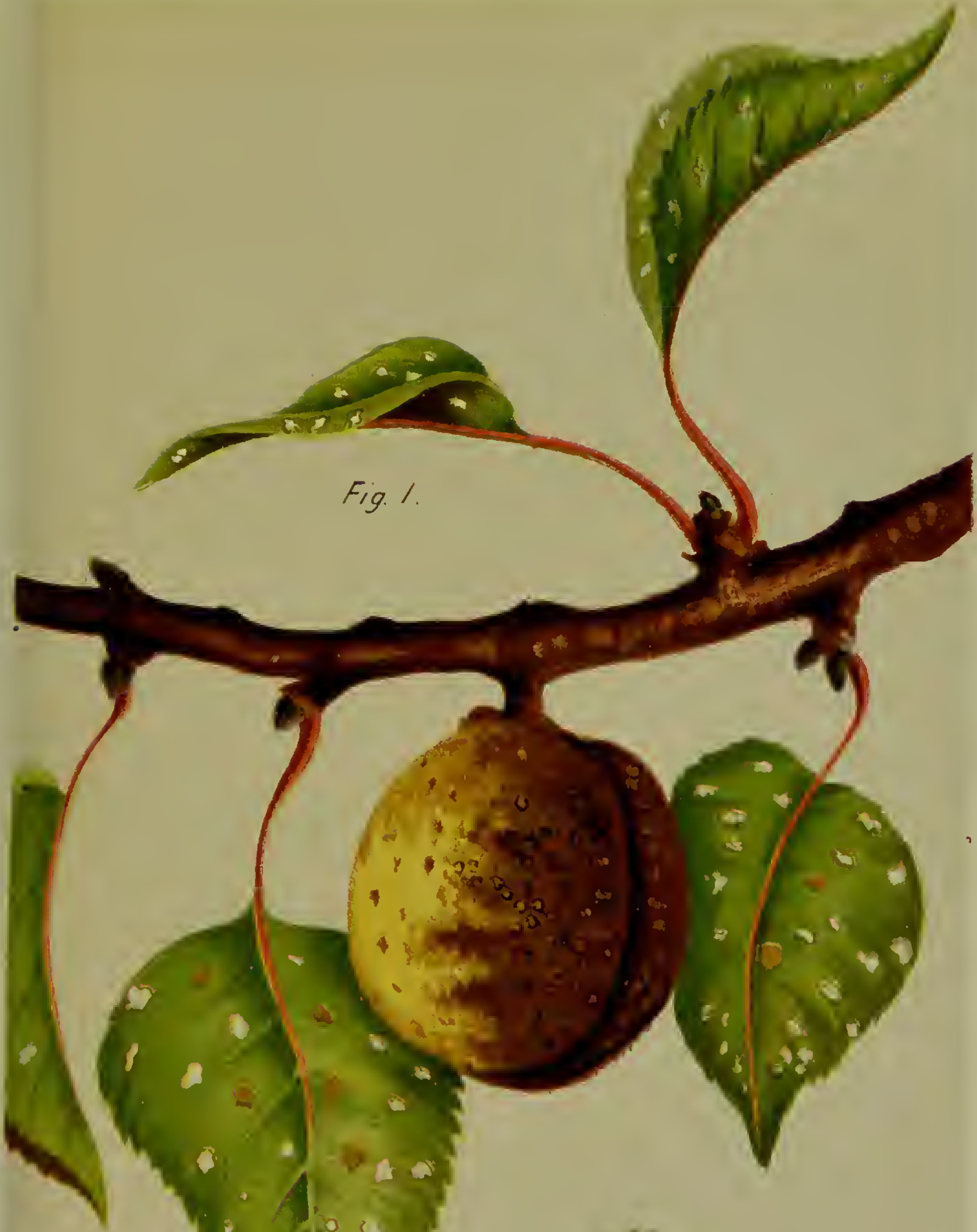

Fig. 1.

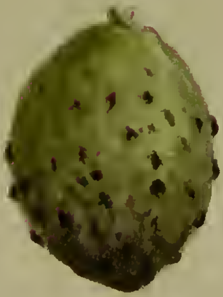

Fig 2.

3. SHOT-HOLE FUNGI.

There is a very familiar appearance in the leaves of many of our stone-fruit trees, where they are more or less punctured with round holes, as if riddled with shot; hence the name of "shot-hole" applied to the injury. At first there are small diseased brown spots, often with a red margin, and soon the pieces fall away, leaving the border quite firm and distinctly circumscribed, due to the formation of a callus or separation layer by the living leaf in order to heal the wound. The cause of this decay of the tissne in definite spots is due to various agencies, but generally to fungi, and although it is commonly attributed to a single fungus in Australia—viz., *Phyllosticta circumscissa*, determined by Dr. Cooke, yet in reality many different fungi are capable of producing the same effect.

This falling away of small portions of the leaf may be regarded in its two-fold aspect of its bearing upon the fungus and of the plant itself.

As far as the fungus is concerned, it will form a convenient means of distribution, and a suitable organic substratum for the production and wintering of the spores, until favorable conditions arise for their development. This development may depend upon the spores germinating in dead material, such as the excised portions of the leaf afford, for Ward has shown in the case of the lily disease due to a *Botrytis* that the fungus is incapable of attacking living organs until it has thus germinated. And if the weather is damp at the period of germination, and the growing portions of the plant consequently tender and susceptible, then the spores will have the best possible chance of infecting the living tissues. Instead of the leaf, as a whole, acting as a host to the fungus, it detaches a number of minute dead portions, each of which may become a centre of infection. In order to realize how widespread this distribution may be, it is only necessary to consider the small size and the immense reproductive power of the "shot-hole" fungi. In a small portion of a leaf 3½ mm. long and 2 mm. broad, I counted 30 perithecia or spore cases, and when it is remembered that each of these contains myriads of spores, it can readily be understood how each little piece of the leaf falling to the ground is an effectual way of perpetuating the species and spreading it over a large area. But this is merely the result of the tree endeavouring to throw off a cause of irritation, for that the formation of the callus in the leaves of stone-fruit trees is an effort of the tree to get rid of the parasite, is evident from the behaviour of such leaves when plucked from the tree and kept moist for several days. In *Phyllosticta prunicola* the mycelium soon begins to spread from the spots to the other portions of the leaf, producing large indefinite patches, which bear innumerable fructifications of the fungus. Here there is no formation of callus, and this following upon the stoppage of the vital activities of the leaf leads to the conclusion that the callus-formation or separation-layer is a special character possessed in particular by the living leaves of the stone-fruit trees, and designed to minimize or localize the attacks of the fungus.

Not only is the leaf affected in this way, but the self-same fungus may cause a "scab" of the fruit and a "brown spot" of the branches, just as many other prominent leaf-fungi may extend their ravages to other parts of the plant. Thus, the well-known peach leaf-rust, which is generally associated with the leaf, may also attack the branches, and has been found on the fruit.

The investigation of the fungi associated with "shot-hole," from various parts of Australia, has shown that different species are concerned in it, but for all practical purposes they may be treated alike. As far as Victoria is concerned the principal fungi have been determined which are associated with it, and a knowledge of their life-history, which is of great assistance in devising preventive measures, has been ascertained.

There are quite a number of fungi known to be associated with "shot-hole," but only those are noted here which are principally responsible for the injury to shoot and leaf and fruit in Australia. I have not as yet attempted to produce the disease by infection experiments, but the constant occurrence of certain fungi on diseased leaf-spots is a strong indication of their causal connexion. In some cases the specimens were kept moist under bell-jars in order to hasten the development of the fructification of the fungus, but such appearances were always taken in conjunction with those presented by the fungus under natural conditions. The following seven are known to cause this injury more or less, the first on the list having been determined for Queensland by Massee, but I have not come across a specimen of it—

1. Cercospora circumscissa.
2. Clasterosporium carpophilum.
3. Phyllosticta prunicola.
4. Phyllosticta persicae (including P. circumscissa).
5. Ascochyta chlorospora.
6. Gnomonia circumscissa.
7. Dematium pullulans.

The multiplicity of forms met with in connexion with shot-hole of stone-fruit trees at different stages of the disease requires some explanation, for it has been the cause of considerable confusion in the past. Thus Dr. Cooke found a *Phyllosticta* in connexion with it, Dr. Ludwig a *Clasterosporium*, and the late Frazer S. Crawford found what he considered to be a *Helminthosporium*, thinking at the same time that the two other investigators had made some mistake. But various forms may be found in connexion with it, according to the season of the year, and the stage of the disease, and a nice point to settle is how far these forms are related. Of course, until cultures are carried out, the genetic connexion between different forms is only a supposition ; still their presence ought to be recognised, and their characters stated, until we are able to bring forward proof one way or the other. If a general view be taken of the cause of shot-hole in the coastal districts, based on the examination of a large number of specimens, it is certain that *Clasterosporium* usually initiates the mischief in the early spring, and spreads it rapidly by means of the multitudinous conidia formed. Then, after the spot is well-nigh exhausted of its nourishment, the *Phyllosticta* may appear, in which the spores are enabled to winter and be ready for the ensuing spring. As corroborating this view, I have met with cases in the apricot, for instance, where the epidermal tissue alone remained in the shot-hole, and was studded with the perithecia of *Phyllosticta*, while at an earlier stage of decay, the *Clasterosporium* alone was found. The one, in fact, is very probably the conidial stage of the other, enabling the fungus to multiply and spread rapidly during the season of the year in which food supplies are most plentiful. The fructification of the *Phyllosticta* only appears when the browning and withering of the part concerned has taken place, and in the wet autumn of 1900 it was found plentifully on the otherwise green leaves still attached to the tree, but in a dry season it can only be readily found later, when the leaves have fallen, and are in contact with the damp earth.

Clasterosporium may be found in full fruit on the young leaves about two weeks after the opening of the buds, while it is not until the middle or end of November that the perithecia of the *Phyllosticta* are obtained, and they are generally only sparsely produced until the end of the summer. In the autumn, if at all wet, the fructifications are numerous.

The *Clasterosporium* is more or less quiescent in December, January, and February, the three hot dry months of the summer. If in summer, leaves showing barren spots are kept for several days in a moist chamber, the *Phyllosticta* is generally produced in abundance, but the *Clasterosporium* has never been obtained in this way, though if leaves with young tufts of *Clasterosporium* upon them are thus treated the fungus grows luxuriantly.

In addition to *Clasterosporium* and *Phyllosticta* on the same shot-hole spot, I have found forms of *Torula*, *Cladosporium*, *Macrosporium*, &c., when the tissue was so decomposed that little was left but the epidermis of the leaf. These fungi evidently act as scavengers and hasten the decay already begun by other agencies.

Among these various scavenger-fungi, as they may be called, there was one form commonly met with growing luxuriantly, and from its frequency worthy of special notice.

Chain-gemmæ.—On the surface of the diseased spot, numerous hyphæ are seen to be undergoing or to have undergone a remarkable change. Here and there longer or shorter wavy chains of moniliform thick-walled cells are seen, some of them detached, others with the still unchanged or empty cells at intervals between. The ordinary delicate, thin-walled, rather elongated cells with colourless contents, have their cell-walls thickened and browned, their contents more concentrated, and their size and shape altered. Transverse septa make them much shorter and they become rounded off. A single bulging cell may be further divided by a transverse septum and constricted there and the material which binds the cells of the chain together may dissolve and set them free. The joints of the mycelium thus altered become resting bodies and are known as *gemmæ*. The chains may be longer or shorter, some of them obtaining a considerable length. The isolated gemmæ may be continuous or 1–2 septate, and constricted at septa.

Although numerous gemmæ were scattered about I did not observe a single one germinating. (Pls. III., IV., V., XXXIV., and LIV.)

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1. *Cercospora circumscissa.* Sacc.

Although various fungi were found associated with the "shot-hole" in Victoria, and a large number of specimens examined, no trace of the above was found. But in the April (1899) number of the *Queensland Agricultural Journal*, Mr. Bailey records it on peach leaves, as determined by Massee. The *Clasterosporium carpophilum* would seem to be its representative here.

This fungus has been very prevalent in California for fully ten years, more particularly on the almond trees, and has caused considerable damage, as well as loss of fruit.

Host-plants and Parts attacked.—In Australia this fungus has only been found upon peach leaves, but it was originally described by Saccardo from its occurrence on plum leaves. It also occurs on almond and nectarine. The leaf is the part most generally affected, but it also attacks the fruit and twigs of almond and peach.

Symptoms.—The young and tender leaf shows yellowish spots, each with a dark centre. Later, tufts of conidia arise mostly in the central area, appearing black, but really dark olive-green, and the margin of the spot becomes dark coloured. The usually circular spot soon dries up and shrinks, and becomes detached from the surrounding healthy tissue, so that the leaf appears as if riddled with shot. The tissue around the spot is thickened and clearly marked off, and it seems that the leaf endeavours to heal the wound produced by the fungus in the usual way by the formation of a callus or protective layer of cork.

The twigs are also affected in circular spots, and the tissue often falls out, leaving a scar; while beyond this the tissue is dark coloured, and probably killed. It likewise produces the circular spot on the fruit and injures the peach, but only affects the husk of the almond.

Nature of Fungus causing Disease.—The fungus producing this disease consists of a vegetative and reproductive portion. The mycelium or vegetative portion ramifies within the tissue of the leaf, winding among the cells and absorbing nutriment from them; then when this has been exhausted within a limited area, the fungus prepares for reproduction. The threads of the mycelium become grouped together into a tubercular mass of thick-walled cells within or beneath the epidermis, and from this arises tufts of upright hyphae bearing the conidia at their free end. These conidiophores, as they are called, may either pass through the stomata or rupture the cuticle.

The conidia are produced in great abundance, and readily detached when ripe. A light shower easily separates them from their attachment and scatters them over the neighbouring foliage, so that it is not to be wondered at that, under such conditions, not a single leaf of a tree escapes infection. The conidia rapidly germinate with moisture, the germ-tubes penetrating the tissue of the leaf, and soon the characteristic shot-hole is produced.

Sometimes conidia are not formed on the characteristic spots, the fungus vegetating in the leaf and destroying the tissue as usual, but the conditions are not favorable for reproduction.

The means provided for the dissemination of this disease are very effective. The premature fall of the leaf will afford a convenient breeding ground, and the small circular pieces detached from the leaf will be scattered hither and thither by the slightest breath of wind. The lightest shower will detach the conidia and supply the necessary moisture for their germination, and thus the infection will spread from leaf to leaf and from tree to tree until none entirely escape.

Effects.—The leaves riddled with holes are unable to discharge their important functions properly, and, as they fall away prematurely before the wood has been properly formed, the fruit-crop of the succeeding season is apt to be seriously affected. A new terminal growth of leaves sometimes appears, as in the case of the "leaf-curl," but this does not repair the damage already done, and where moisture is deficient this does not even occur, so that the imperfectly formed wood is exposed to the extremes of drought and heat.

The branches, too, are considerably affected by the fungus. The outer tissue is mostly destroyed, but sometimes the inner tissue even to the cambium layer is affected.

Injury is thus done to the tree as a whole, in addition to its being rendered comparatively unfruitful.

Geographic Distribution.—This parasite has been found in Britain, Italy, and France, as well as in Australia and California. In the coast region of California it has been most injurious, on account of the humidity of the atmosphere favouring its development and spread. It has only been recorded from the neighbourhood of Brisbane in Queensland, and Mr. Bailey refers to it as follows:—"This fungus, which, during the past year (1898), might have been noticed from the circular holes it has left in the leaves of the peach trees about Brisbane, does not seem to have considerably interfered with the productiveness of the trees."

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PLATE VI.

SHOT-HOLE FUNGUS (*Clasterosporium carpophilum*).

Fig.

1. Peach twig showing spots on both green and dead portion, with minute black points produced by *Cytospora leucostoma* towards apex.

2. Portion of peach twig with *Cytospora leucostoma* showing spores being emitted in the form of red curls. This is only apparent under moist conditions. When dry the appearance is as shown at B, due to the presence of crystals.

3. Peach fruit from Western Market, Melbourne, showing "scabbing" (26/3/99).

Plate VI.

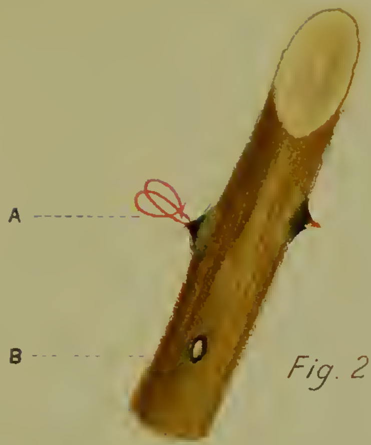

Fig. 2

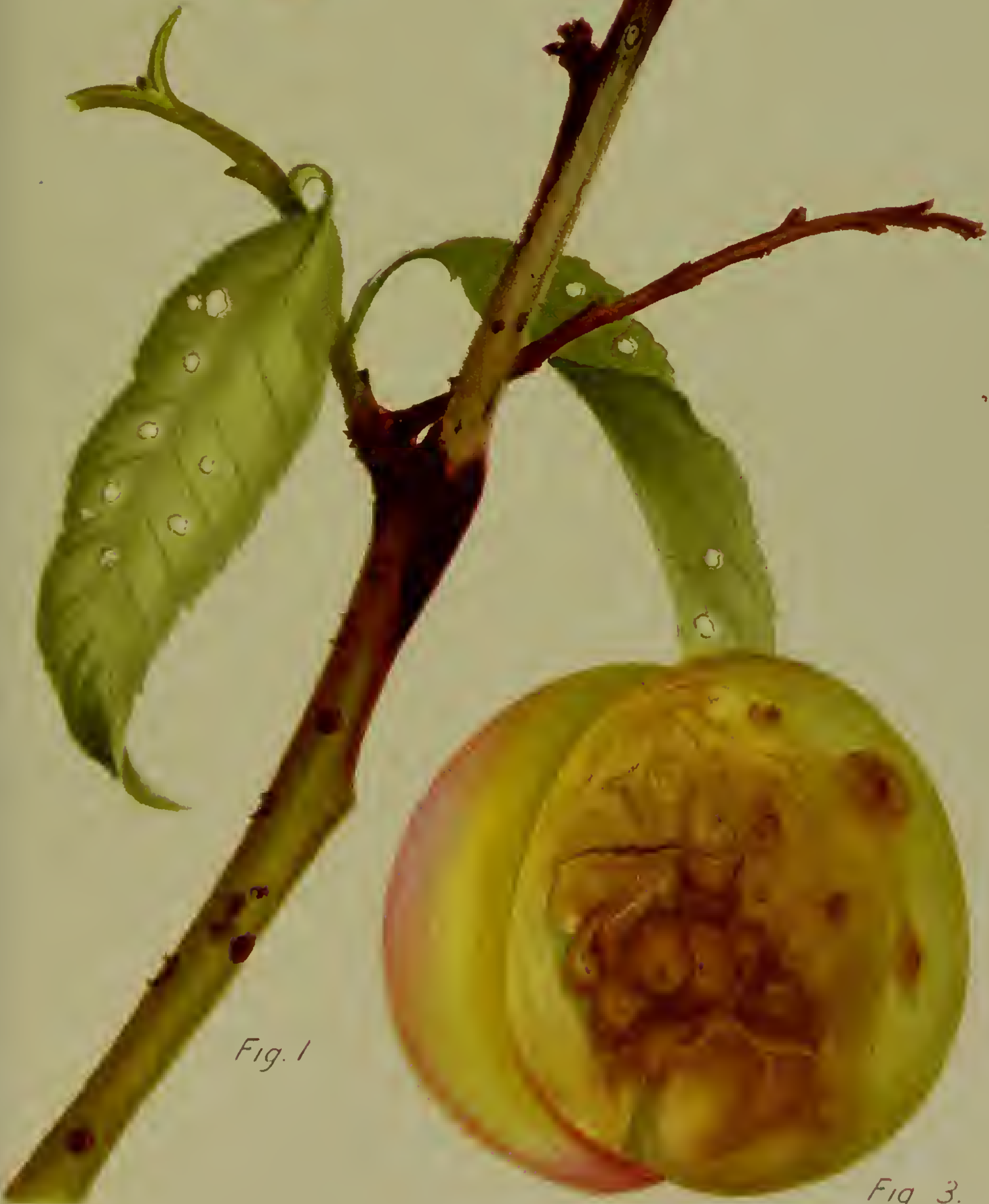

Fig. 1

Fig 3.

2. *Clasterosporium carpophilum.* (*Lev.*) Aderh.

This fungus is the most common cause of the "shot-hole" in stone-fruit trees in Australia, and has been recorded as far back as 1883 for South Australia under the name of *Sporodesmium amygdalearum*, Pass., although this is the first time it has been noted for other parts of the Continent. In Victoria it has probably been producing "shot-hole" for a considerable period, although its presence was unsuspected. It has not been found as yet in the fruit-growing districts north of the Dividing Range, such as the Goulburn Valley, Horsham, or Mildura, but in the coastal districts it is very prevalent.

Host-plants and Parts affected.—It has been found on all the stone-fruit trees grown here, with the exception of the cherry, viz.: almond, apricot, peach and plum. According to Thuemen, it is most common in Europe on apricots, almonds and cherries, while peaches and plums are less subject to attack; but here it is common enough on plums and peaches, the latter being affected on twigs and fruit as well as in leaf.

The leaves were affected as well as the fruit of apricot and peach, and it also commonly occurs on peach twigs associated with gumming.

Occurrence.—It is found more or less common all the year round in the coastal districts, either on leaves, or twigs, or fruit; but in the heat of summer it is very rarely found except on the fruit. This capacity for living on different portions of the tree enables it to extend its period of active growth, so that the fall of the leaf or the fruit does not prevent its still flourishing on the twigs. As early in the season as July the leaves of the almond just opening were effected, and conidia of the previous season were commonly found germinating. On 23rd September it was found on peach leaves about a week old and before they had fully expanded, and on 24th September on apricot leaves about one-third grown. The fruit-clusters occurred on the spots falling out, and some of the conidia were germinating. By the end of December it was very plentiful on the fruit of the apricot, causing "scabbing," and also occurred on leaves and young shoots. About the middle of March it was also found on dead twigs of peach.

Symptoms.—It has a very characteristic appearance on the different portions of the tree, and not merely in the "shot-hole" effects produced on the leaf.

(*a*) Leaves.—The spots are circular, or nearly so, ochraceous to brown, with a dark-red margin, and ultimately falling out, leaving a clean-cut hole. Small greyish to dark-coloured tufts may be seen with the naked eye on the spots on both surfaces of the leaves, but mostly on the upper; the spots, however, may be sterile, and only show under the microscope the mycelium or threads of the fungus. In the month of May, when the leaves are preparing to fall, the upper surface of the peach leaf often becomes covered with numerous blotches. Round spots of a biscuit colour, surrounded by vinous brown or purple, occur solitary, or usually run together, forming large irregular patches, and tufts of the fungus appear upon them. The ordinary shot-holes are not formed, although produced a little earlier in the season, and it would appear that the leaf at this stage has not sufficient vigour to form a callus and detach the spot.

(*b*) Twigs.—The spots either on the living or dead branches are about 2 mm. in diameter, somewhat depressed, and with a raised ruddy margin. The spots may often be seen splitting at the margin and preparing to fall away, covered with the fructification, just like the ordinary "shot-hole" of the leaf.

(*c*) Fruit.—In the peach it forms depressed oval to circular patches of a greyish-brown colour, becoming confluent, with small elevated portions towards the centre of each patch. In some cases a circular patch is cut out and becomes detached, just as in the shot-hole of the leaf. In the apricot the "scab" begins as a small, round, dull crimson spot, the centre of which is yellowish to greenish or greyish. This spot gradually enlarges, and becomes dark-green to black. It is raised a little, and gradually cut off from the surrounding tissue. The spots multiply excessively, more particularly towards the basal or stalk end of the fruit, and run together, so that there may be produced extensive patches of dirty greenish-grey scab. This begins to crack, and portions flake off, till finally it becomes the corky-brown scab, with scurfy greenish flakes on top.

Effects.—The leaf is riddled as if with small shot, and its activity and usefulness thereby impaired, the green shoots are deprived of their full supply of nourishment, and the formation of healthy wood is hindered, while the "scabby" fruit does not reach its full size, is wanting in flavour, and tends to become rotten. In severe cases of "shot-hole" the trees may be almost defoliated, and under these circumstances they put forth new foliage, which means immature wood in a sappy condition, and specially liable to injury from frosts. Hence the indirect effects of this disease may be very serious.

Nature of Fungus causing Disease.—The fungus filaments ramify in the tissue of the leaf and disorganize it, while very short tufts of hyphae rupture the epidermis and produce at their tips spindle-shaped or elongated-elliptical conidia of a dilute olive colour which are readily detached and easily spread. On the fruits the fungus filaments also ramify beneath the surface and produce "scabbing." The outer tissue becomes corky, drying up and flaking off, and carrying away innumerable conidia with it.

The *Clasterosporium* not only produces its fructification on still living tissue, but also on tissue that has been dead for some time. On a peach twig which had been dead for over six months the tufts were found producing fresh conidia, thus showing the necessity for removing all dead wood as well as other diseased portions.

The mode of infection has been clearly observed. Around the buds and among the bud-scales there are innumerable conidia, some of them actually germinating and others ready to germinate. The young leaves are at once attacked, and the shot-hole effects quickly produced. Thus by means of conidia alone this fungus is able to continue its course from year to year if the conditions are favorable, and by means of its dissemination from minute cast-off portions of the tree it is readily carried from tree to tree or from orchard to orchard, so that it spreads with amazing rapidity. I have found the fungus all the year round in every month, but when the conditions do not favour the conidial mode of reproduction then possibly its existence may be continued by means of spores.

The same Fungus under other names.—A disease has appeared on peaches in America known as "Brown or Pustular Spot." It occurs on ripe or ripening fruit in the form of numerous pimply red spots with light-brown centres. It was first described by Taft in 1893, and referred to *Helminthosporium carpophilum* Lev. This fungus was found on peach fruit in Paris in 1843, and is identical with *Clasterosporium.*

There is another fungus, which is said to cause gumming of the cherry and allied trees, so closely resembling it that it also may be taken as the same. It attacks the various stone-fruit trees, causing "shot-hole" of the leaf, diseased patches on the twigs, and drying up or mummifying of the fruit, and is known as *Coryneum beyerinckii*, Oud. The appearance of the fruit clusters, and the size, shape, and colour of the conidia are so alike, particularly on diseased and gumming patches of the twigs, that I have no hesitation in classing these two parasitic fungi together. Still, it is a remarkable fact that so far I have not observed any *Clasterosporium* on the cherry.

In 1882 the late Frazer S. Crawford sent from South Australia to Dr. Cooke some apricots affected with a pustular disease or scab. The fungus was determined as *Helminthosporium rhabdiferum*, B. and Br., but Crawford would not agree that it was this species, but rather considered it an undescribed species of *Helminthosporium.* In March, 1900, some ripe peaches were sent to me with an effused black fungus associated with gumming. It formed circular patches ½ to ¾ inch diameter, more or less surrounded with the dense black fungus, bearing innumerable conidia. It had all the characteristics of *C. carpophilum*, and this was doubtless the fungus on the apricots sent from South Australia, and determined as *Helminthosporium rhabdiferum* (Pls. VIII. and XLVIII.).

Geographic Distribution.—It occurs in Italy and Switzerland, Germany and Austria, and has a very wide distribution, often taking the form of an epidemic, as it does with us. It is also known in the United States under the name of *Helminthosporium carpophilum*, Lev. I have only determined it for Victoria, South Australia, and New Zealand, but since "Shot-hole" is prevalent in the other States of Australia, it probably exists there as one of the fungi causing it (Pls. VI., VIII., Fig. 3, XVIII., XXX., XXXI., XXXII., XXXIII., XLVIII., XLIX., L., and LI.)

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3. *Phyllosticta prunicola.* Sacc.

Although this fungus has not been recorded for Australia before, it is very common on all the cultivated stone-fruit trees, and causes a considerable amount of damage, not only to the leaves, but likewise to the fruit. "Shot-hole" in the leaves and "scabbing" in the fruit has been known for a long period, particularly on the apricot, but the perfect form of the fungus producing the disease is not always easily obtainable. It is well-named by Massee in his "Text-book of Plant Diseases" the Australian "Shot-hole Fungus," for it is exceedingly common in the coastal districts at least.

Host-plants and parts affected.—It has been found on the almond, apricot, cherry, peach, and plum, as well as on the leaves of apple, and leaves and fruit of the vine in Australia. It attacks the living leaves, and completely riddles them with holes, often leaving not a single leaf unaffected. It has also been found on the fruit of the apricot, and on the twigs of the almond, apricot, and peach.

Occurrence.—It appears on the living leaves or shoots as early as the middle of November, and has been found more or less prevalent in all the intervening months up to the end of May. On the ripe fruit of the apricot it appeared in January, and in early spring of the succeeding season (September) rotten apricot fruits were picked up shrivelled and dark-green, almost black, and found to be profusely covered with perithecia, containing numerous spores. During the winter months the fungus rests on the fallen portions of the leaves or the rotting fruit, and in the spring is ready by means of its spores to attack the fresh growth.

Careful watch was kept for the first appearance of the *Phyllosticta* both naturally and in cultures; the former being on 21st November, and the latter a week earlier, in 1900. In 1901 the first appearance was on plum leaves (11th November).

At Armadale the *Clasterosporium* was the only shot-hole fungus found in the early part of the season, and *Phyllosticta* almost exclusively after the middle of November, but in March the *Clasterosporium* again made its appearance in profusion. The different seasons for these two fungi probably hold good for their occurrence elsewhere in Australia.

Symptoms—*(a) Leaf.*—Small brown spots appear on the upper surface, which gradually become dry and brittle. The circular cut may start from the under surface, even when the brown spot on the upper surface is not yet definitely shaped, then it gradually reaches the upper surface, and the clean-cut, brown, brittle patch drops out, leaving the leaf as if riddled with small shot. Careful search is needed to find the perithecia on the leaves still borne by the tree, as the brown spots usually fall away before developing the perithecia. Towards the end of the season (May), when the leaves are preparing to fall this fungus may be found on the brown withered tips and margins without producing definite shot-hole spots, although these were formed earlier in the season. This happened in plum, apricot, and peach.

(b) Fruit.—On the ripe fruit of the apricot, examined in January, the "scab" was being detached in flakes and each flake was studded with numerous perithecia filled with sporules. Rotten and shrivelled fruits picked up from the ground in winter were found to be profusely covered with perithecia, filled with innumerable spores, and such fruits undoubtedly serve to tide the fungus over to next season.

(c) Twigs.—There are usually round to oval raised brown patches, which may ultimately become greyish and split up. The perithecia are generally scattered over these patches as minute black punctiform bodies.

Effects.—Most growers do not sufficiently realize how injurious it may prove to a tree to have deficient leaf surface. The transpiring surface is lessened, and this injuriously affects the roots, the process of assimilation is interfered with, and the wood that is formed is of poor quality, and more likely to succumb to frosts, and the resulting fruit-buds are imperfectly nourished. It not only deteriorates the quality of the fruit, but shortens the life of the tree and gradually saps its vitality.

Nature of Fungus causing Disease.—I have found this fungus on the shoots, the leaves, and the fruit. It occurred on the wood formed in the spring, and, when examined towards the end of July, the outer surface of the shoots showed considerable damage. The bark was much cracked and peeling off, and the woody tissue was exposed. The perithecia were forming at the margin of the diseased tissue, and by the time the leaf-buds were developing, the spores were being discharged in myriads, ready to attack the fresh and succulent growth.

The diseased spots of the leaf show the minute black punctiform, scattered pustules, and each pustule contains innumerable spores of a dilute olive colour. The small round spots of the leaf which fall away carry the fungus with it, and on the ground or in crevices of the bark of the tree it probably passes the winter.

Geographic Distribution.—It occurs on the Continent of Europe, in Germany, and Italy, but has not yet been recorded for America. It has only been definitely determined for Victoria, South Australia, and Queensland, but probably exists in the other States as well (Pls. IV., Figs. 4 and 5, XX., XXIII., and XLVII.).

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4. *Phyllosticta Persicæ.* Sacc.

(Including *P. circumscissa*, Cooke.)

On the ordinary brown shot-hole spots, and generally on the lower surface there is occasionally found a species of *Phyllosticta* with colourless sporules agreeing with those of the above species which was constituted by Professor Saccardo in 1879. It has only hitherto been recorded on peach leaves in Italy, but has now been found on peach, apricot, and plum leaves at Armadale, and on apricot leaves sent from South Australia. At first there was no evident fungus on the South Australian specimens, but on keeping the leaves moist, the perithecia appeared on the spots, particularly on the lower surface. The fungus is so comparatively rare that it does not seem to be of great economic importance in Australia, but acquires a certain interest from its being probably the fungus named by Dr. Cooke as *P. circumscissa*. It may, however, prevail in certain seasons, for in November, 1901, it was found on apricot leaves, riddled as if with shot, when no *P. prunicola* had appeared and only *C. carpophilum* was plentiful.

Although *P. circumscissa* is so commonly mentioned in connexion with shot-holes in Australia, it does not appear to have been definitely determined by any one but Dr. Cooke himself. It is rather a remarkable fact that, although I have spent more than ten years in investigating the diseases of plants in Australia, that special fungus has not come under my notice. Over a thousand leaves from various parts of Australia and New Zealand have been subjected to the most critical examination, and wherever the shot-hole was due to a *Phyllosticta*, it was usually found to be *P. prunicola*, and very occasionally *P. persicæ*. It so happens, however, that the sporules of the latter are sometimes so similar to those of the fungus described by Cooke in 1883 that I have come to the conclusion that they both represent the same fungus on different host-plants, and so I have included the "shot-hole" fungus of Cooke under the previously determined one of Saccardo (Pl. XXIII., Figs. 68, 69, and Pl. LIV., Fig. 316.)

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5. *Ascochyta chlorospora.* Speg.

This fungus was first found on languid leaves of the plum in Italy, and has now been met with in Victoria. It is one of the fungi causing "shot-hole" at Ardmona, in the Goulburn Valley, where neither *C. carpophilum* nor *P. prunicola* occur. It is found associated with *Gnomonia circumscissa*, also a shot-hole fungus, and may be its pycnidial stage. It occurs on the almond, apricot, peach, plum, apple, and vine leaves, also on apricot stones and shrivelled peaches. The peaches were plucked in September, but had remained on the tree for nearly twelve months, having never come to maturity. In midsummer it was found at Ardmona on "shot-hole" of apricot, peach, and plum leaves in moist chambers, but in midwinter it was fairly plentiful on fallen leaves (Pl. XXIV., Figs. 75, 76.)

6. *Gnomonia circumscissa.* McAlp.

This is a new species which has been found on both living and dead leaves of the various stone-fruit trees growing here, viz., almond, apricot, cherry, peach, plum, and Japanese plum. It occurred on definite "shot-hole" spots, as well as scattered promiscuously over the dead leaves. It has also been found on apple and vine leaves. There were no special symptoms to indicate the presence of this fungus, further than the ordinary "shot-hole" effects, but it is interesting to consider the fungi with which it was found associated.

As there are good grounds for believing that this is the highest stage of an imperfect form of fungus, it will be convenient to place the facts together in their proper connexion.

1st. *C. carpophilum* is the most common form of "shot-hole" fungus, and may either occur alone or be accompanied by *P. prunicola*. The latter fungus has been found growing among the tufts of *Clasterosporium*, and may either succeed or be associated with the former. This association is a pretty good indication, in the absence of infection experiments, that the one (*Clasterosporium*) is the conidial stage of the other (*Phyllosticta*).

The succession of events in the "scabby" fruit of the apricot is a striking corroboration of the genetic connexion between the two fungi. In December unripe apricots were very "scabby" on a tree badly affected with "shot-hole," and on examination they were found to be thickly studded with the fruit-clusters of *Clasterosporium*. In January, ripe and "scabby" apricots from the same tree had the flakes that were being thrown off thickly covered with *Phyllosticta*, and in September, the rotten and shrivelled apricots left lying on the ground were just one mass of perithecia. It is reasonable to conclude from this that the fallen portions of the leaves likewise develop the perithecial form of the fungus. On the other hand on the apricot fruit the scabs caused by *Clasterosporium* in the spring are generally dark, circular, elevated, and hairy, while those due to the *Phyllosticta* are pale, smooth, plane, and expanded.

2nd. *G. circumscissa* is the ascidial or highest form of some fungus, and may be genetically connected with the preceding. It has been found associated with the *Clasterosporium* on the plum leaf and with the *Phyllosticta* on the apple leaf, but it is not nearly so common as these two stages, at least at the season when I made my examination. In connexion with the apple leaf it is worth noting that after the discovery of *G. circumscissa* on the plum, I surmised that it might also be found on the apple associated with *Phyllosticta*, and sure enough it was found there. If we accept the view that these three fungi represent different stages in the same fungus form (and a similar life history has been proved in other cases), then the life history of the shot-hole fungus would be represented as follows :—

1. Conidial stage (*Clasterosporium*).
2. Pycnidial stage (*Phyllosticta*).
3. Ascidial stage (*Gnomonia*).

As against this view it may be noted that *Gnomonia* is found in the Goulburn Valley on living leaves and dead fallen leaves, but exhaustive research has failed to reveal the presence of either *Clasterosporium* or *Phyllosticta*. *Ascochyta chlorospora*, however, was found on the same "shot-hole" spots with *Gnomonia*, and it may be that while *Clasterosporium* and *Phyllosticta* are connected, *Gnomonia* is the complete stage of *Ascochyta*. If this be so then the life histories would be represented as follows :—

1. Conidial stage (*Clasterosporium*).
2. Pycnidial stage (*Phyllosticta*).

1. Pycnidial stage (*Ascochyta*).
2. Ascidial stage (*Gnomonia*).

(Pl. XXI., Figs. 50, 51, 52).

7. *Dematium pullulans.* DeBary.

While investigating the cause of the "shot-hole" disease of stone-fruit trees in the Ardmona (Goulburn Valley) district in October, 1900, the fungi concerned were found to be quite different from those in the neighbourhood of Melbourne. At that time *Clasterosporium carpophilum* was very prevalent near Melbourne and other coastal districts, but repeated examinations of affected leaves from Ardmona and other interior districts had failed to reveal that fungus. Instead, minute white patches were found on the brown spots of the leaves. On placing in a moist chamber leaves of peach, apricot, and plum this fungus attained on the brown spots profuse development in about five days, later spreading over a large part of the leaf. Similar results were obtained from almond and apple leaves from other widely-separated districts.

Host plants and parts affected.—It was found on all the stone-fruit trees, and also on the apple and vine. It occurs mainly on the leaves, but the fruit of the peach, apricot, almond, fig, cherry, poppy, vine, and apple were also affected.

Symptoms.—There are the usual "shot-hole" effects produced, but it is not always easy to tell the cause without microscopical examination. Minute white often confluent patches appear on brown spots of leaf which ultimately fall away, leaving a "shot-hole." On leaves in moist chambers ochraceous or olivaceous irregular blistered patches may also occur, raising and finally rupturing the epidermis. The patches may appear either on the upper or under side of the leaf. On the seed of the almond it appeared as a black sclerotioid mass.

Nature of Fungus causing Disease.—Although in the absence of pure cultures and inoculations one cannot definitely say that a fungus causes a disease, and yet on "shot-hole" spots fungi are often found which are simply there as scavengers to complete the work of destruction already begun, still, in the present instance, where this fungus alone was constantly found associated with "shot-hole," it is highly probable that it is the cause of the injury in the absence of any other possible factor. This probability receives confirmation from the fact that this fungus undoubtedly is the cause of a serious disease of the grape in the same locality. The filaments of the fungus ramify in the tissues, and may either directly give rise to fertile filaments which bear at their free usually swollen ends a number of conidia (3 to 7), or the filaments may form compact tubercles from which the fertile hyphæ may arise. The detached conidia which lie around in immense numbers multiply by budding in a yeast-like manner, and thus the disease may be readily spread.

Geographic Distribution.—This fungus in its various forms is widely distributed, and by those who regard it as a stage in the life-history of *Cladosporium herbarum*, it would be considered of almost universal occurrence. (See also pp. 86, 107, and 162.) (Pls. XVII., XXIX., XXX., and LI.).

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Treatment of "Shot-hole."—Several fungi are concerned in the production of "shot-hole," and may either occur simultaneously or separately, but a general treatment may be applied to the whole.

1. As the "shot-hole" fungi may occur on the shoots and fruits as well as on the leaves, the former should be removed and burnt when the disease is observed on them. The object in doing so is to destroy the fungus in its early stages, and thus limit the spread of the spores.

2. Remove all dead wood from the tree and burn it, since the fungus may grow and produce its spores there, and thus infect healthy parts.

3. Spray with Bordeaux mixture generally, as for leaf-curl, and just before the bursting of the buds. At the North Carolina Agricultural Experiment Station an entirely satisfactory remedy was found in the copper sulphate-lime-molasses mixture, which consisted of 4 lbs. copper sulphate, 4 lbs. unslaked lime, 1 gallon of molasses, and 45 gallons of water.

PLATE VII.

PEACH FRECKLE (*Cladosporium carpophilum*).

Fig.

1. Ripe peach with diseased spots or freckles on one side.
2. Section of diseased peach, showing decay and shrivelling setting in.
3. Unripe green peach affected with "freckle."

Plate VII

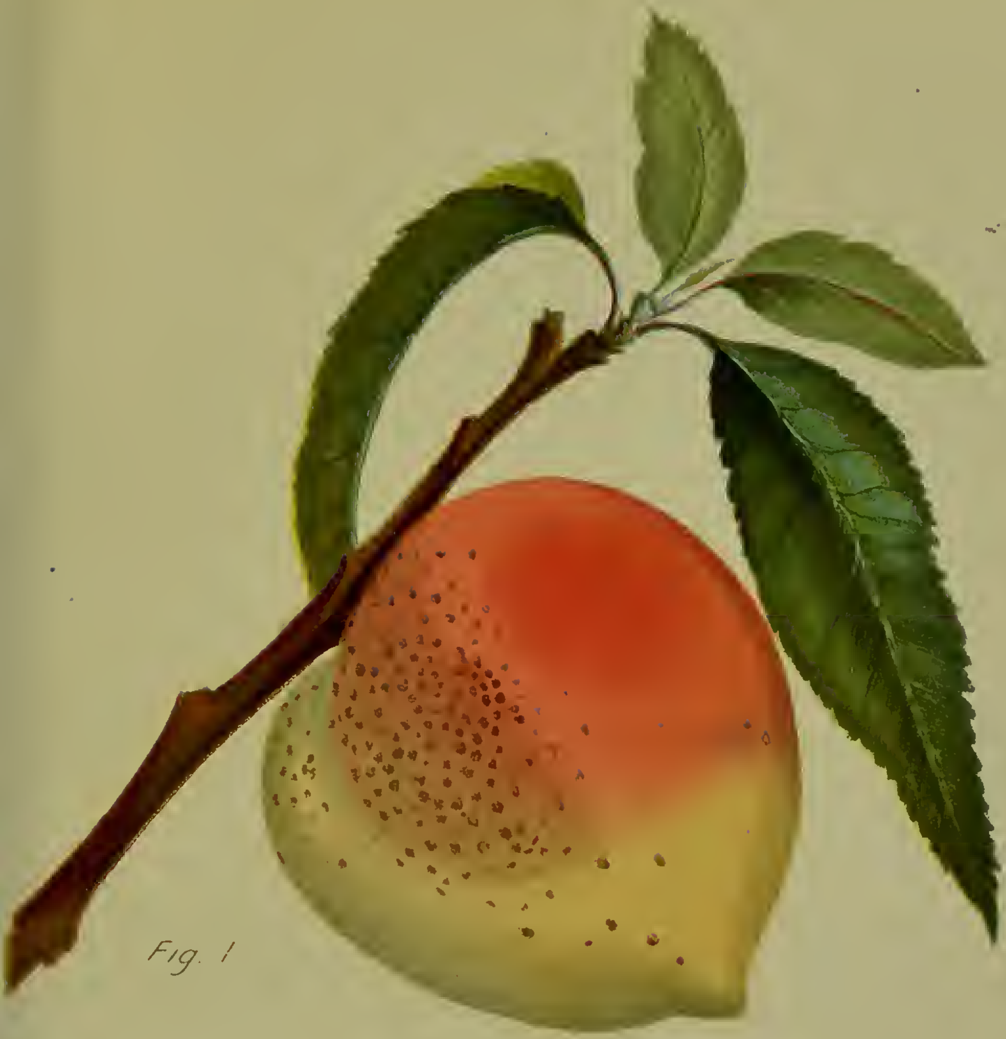

Fig. 1

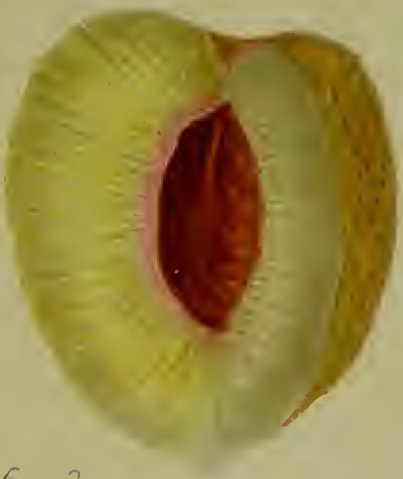

Fig 2

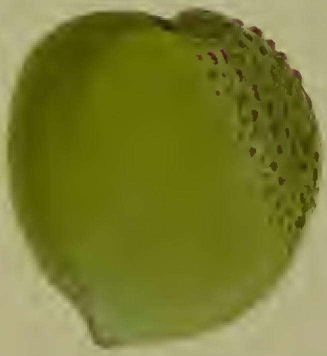

Fig 3.

4. PEACH FRECKLE.

(*Cladosporium carpophilum.* Thuem.)

This is a disease which has not yet been met with in Victorian orchards, but since it is being introduced on peaches imported from Sydney, it is necessary to call special attention to it, in order that it may be rigorously excluded.

The disease has been known for a considerable time, and was first discovered in 1877, by Baron von Thuemen, in Austria. It caused quite an epidemic there among ripe peaches in the years 1876–77, and produced considerable injury, besides favouring a very rapid decay of the fruit. It has since been found in the United States and Canada, and as far back as June, 1894, it was regarded as a common disease in New South Wales, causing the peaches to crack and ultimately become rotten and worthless. It is especially prevalent on late peaches.

Common Name.—It is known under different common names. In the United States it is usually called "Scab," or "Black Spot," because it somewhat resembles Apple Scab, due to *Fusicladium*, a disease very commonly called "Black Spot" with us. The name "Peach Freckle," however, is so expressive of the spotting of the fruit and the appearance presented, that I have adopted it in preference to the others.

Host-plants and parts attacked.—In addition to the peach, it has been found in New South Wales on nectarine, and in America on apricots and plums, cherries and almonds. Until comparatively recently the fungus causing this disease was supposed to confine itself to the fruit, but in America it has been found upon the leaf, and then to pass the winter in the sterile resting condition on the twigs of the previous season's growth.

Symptoms.—In January the disease is very common, and then the fungus usually covers one side of the ripe peach with numerous minute round spots or freckles, which are greenish at first, then brownish, or olive-brown. These spots finally run together, and form one continuous dingy brown mass, which usually cracks and leads to the rapid decay of the shrivelled fruit. The spotting of the fruit is very marked, but I have not met with the disease on leaf or twigs.

Effects.—The effects of the disease have already been indicated. On half-grown fruit the spots appear, and thus it is prevented attaining its full development. Then as it ripens, scabs are formed which crack, and the fruit becomes a prey to various rotting fungi. It is a very destructive disease, and since it is epidemic in its nature, it should be combated by the combined action of peach-growers.

Fungus causing disease.—The fungus causing the disease is known as *Cladosporium carpophilum.* It is closely allied to *Fusicladium*, which causes the "scab" of the apple, and this affinity suggests similar treatment. The second or specific name simply means fruit-loving, from its specially attacking the fruit.

The mycelium or spawn of the fungus creeps over the surface, and also vegetates immediately beneath the cuticle.

Geographic Distribution.—This disease has been recorded from Austria in Europe, the United States of America, and Canada, and from New South Wales. Wherever it occurs, it spreads rapidly, and becomes epidemic in its character.

Treatment.—The accurate determination of the fungus causing any disease is necessary to enable us to apply rational treatment; and when the determined fungus is closely allied to some one to which successful treatment has already been applied, then the suggestion can be acted on at once. *Fusicladium*, or "scab" of the apple, is so closely related to this fungus that it was originally considered to be a *Cladosporium*, and since both occur on leaves and twigs, their life-histories seem to run parallel. Hence the measures taken in dealing with black spot of the apple may safely be tried here, making due allowance for the delicacy of the peach leaf and fruit, as compared with those of the apple.

Since the fungus occurs on the shoots and leaves as well as on the fruit, it will be necessary to give the tree a thorough winter cleaning.

For winter use 5 lbs. sulphate of copper, 5 lbs. lime, and 45 gallons of water may be used, and if the soil is sprayed as well as the trees, a single winter spraying may suffice, unless the weather is particularly favorable for the disease. (Pl. VII. and Pl. XVIII., Figs. 24, 25.)

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PLATE VIII.

Fig.

1. Peach with large brownish-grey patches caused by rust (*Puccinia pruni*).
2. Peach destroyed by "ripe rot" (*Monilia fructigena*).
3. Peach with large black patches caused by *Clasterosporium carpophilum.*

Plate VIII

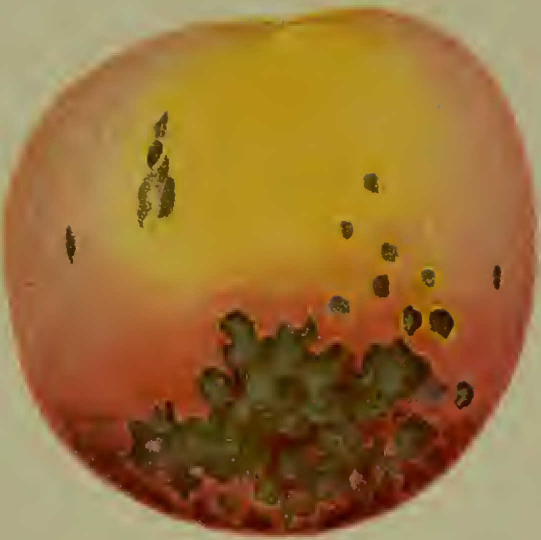

Fig 1

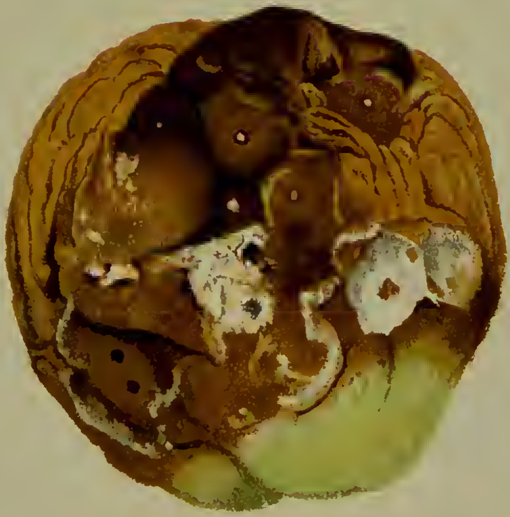

Fig. 2

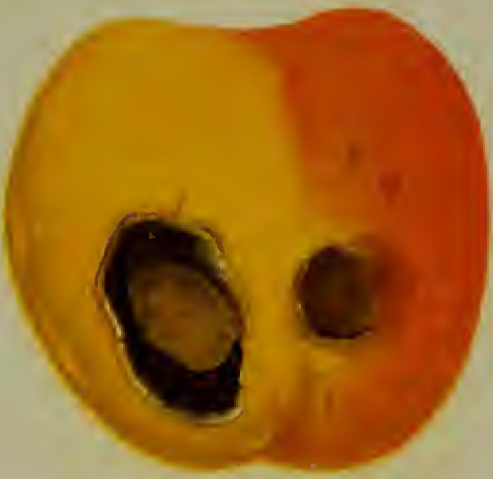

Fig 3

C. C. Brittlebank Del

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5. BROWN ROT.

(*Monilia fructigena.* Pers.)

This is a disease which not only attacks the fruit but likewise the twigs, and the rotten fruit is nearly always attached to the diseased and withered twigs. This rotting of the fruit is generally attributed to the weather, but a fungus will be found associated with it. Fungi are favoured in their growth by warm weather, and if this is accompanied by moisture, particularly near the time of ripening, then the rot will spread with rapidity and the fruit suffer accordingly. The fungus causes the rot, and the weather is simply a condition acting favorably or unfavorably towards its development.

Host-plants and parts affected.—This disease has been found here in peaches, plums, apricots, and cherries, but it also occurs on stone-fruits generally. It is most noticeable in the fruits as it causes them to rot, but the twigs are also affected and destroyed by it, causing what is known as twig-blight.

Symptoms.—The rotting of the fruit is the most striking symptom, with the ash-coloured spores produced on the surface. The rotted fruit generally dries up and forms the shrivelled "mummy" peaches, often seen hanging to the dead branches.

Effects.—The blighting of the twigs in the early spring is most serious in its effects, often causing the blossom to wither, and consequently an absence of fruit. In the fruit it disorganizes the tissues, and the entire destruction by rotting takes place.

Nature of fungus causing disease.—The fungus causing this disease must gain entrance into the branches or fruits before it can cause injury. The spores may enter the twigs through the blossoms, and the slightest puncture of the fruit by insects or other agency will induce that entrance. It consists of a luxuriant branched and septate mycelium which soon kills the tissues, causing them to turn brown. Then the reproductive bodies or conidia are produced at the surface in such countless numbers as to give the portion attacked an ashy-grey appearance. These conidia are readily distributed by the wind, rain, or insects. Thus the disease is spread often in the form of an epidemic. The mycelium is present in a resting state in the fallen or mummified fruits, and probably also in the blighted twigs, so that by this means the fungus tides over the winter.

Geographic distribution.—This fungus is widely distributed and attacks a large number of fruits. It is common in Europe and America, and also in Australia, although the fungus origin of the rotting of the fruit is not generally recognised. It is said to be one of the worst fungus diseases of the peach over large portions of the United States.

Treatment.—It is evident that all diseased fruit should be burnt in order to prevent the disease spreading. Not only should the fallen fruit be gathered and burnt, but the rotten fruits should be removed as they appear on the tree.

Spraying is also recommended, and Bordeaux mixture may be used just before the blossoms open, and again when the fruit has set. It could be applied same as for peach leaf-curl (Pl. VIII., Fig. 2, and Pl. XVI., Figs 7 and 8).

REFERENCES.

Massee (G.)—"Text-book of Plant Diseases," p. 300. London (1899).

Smith (E. F.)—"Peach Blight." Journ. Mycol., Vol. VII., p. 36 (1891).

PLATE IX.

BARK ROT (*Polystictus cinnabarinus*).

Fig.

1. Apricot tree with fungus on stem and branches. (Drawn from photo.)

Plate IX

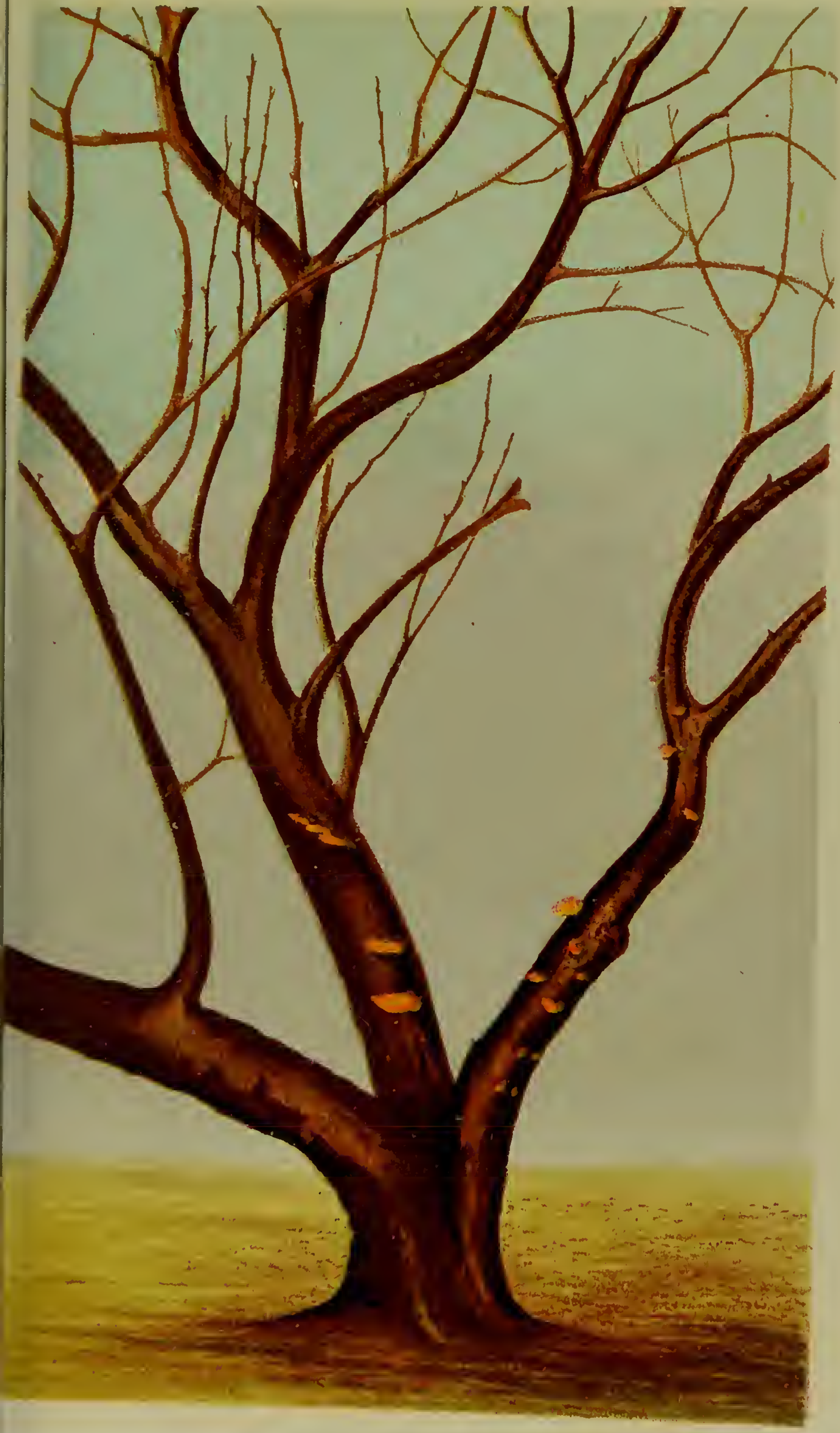

PLATE X.

Fig.

1. Apricot branch with *Polystictus cinnabarinus.*
2. Portion of branch with *Schizophyllum commune* (natural size).
3. Spores of *P. cinnabarinus* (× 1000).
4. Under surface of *S. commune,* showing radiating gills (natural size).
5. Spores of *S. commune* (× 1000).
6. *Polyporous lentus* found on stem of living apricot tree, and imbedded in the bark by a dense white mycelium which killed the part to which it was attached (natural size).

Plate X

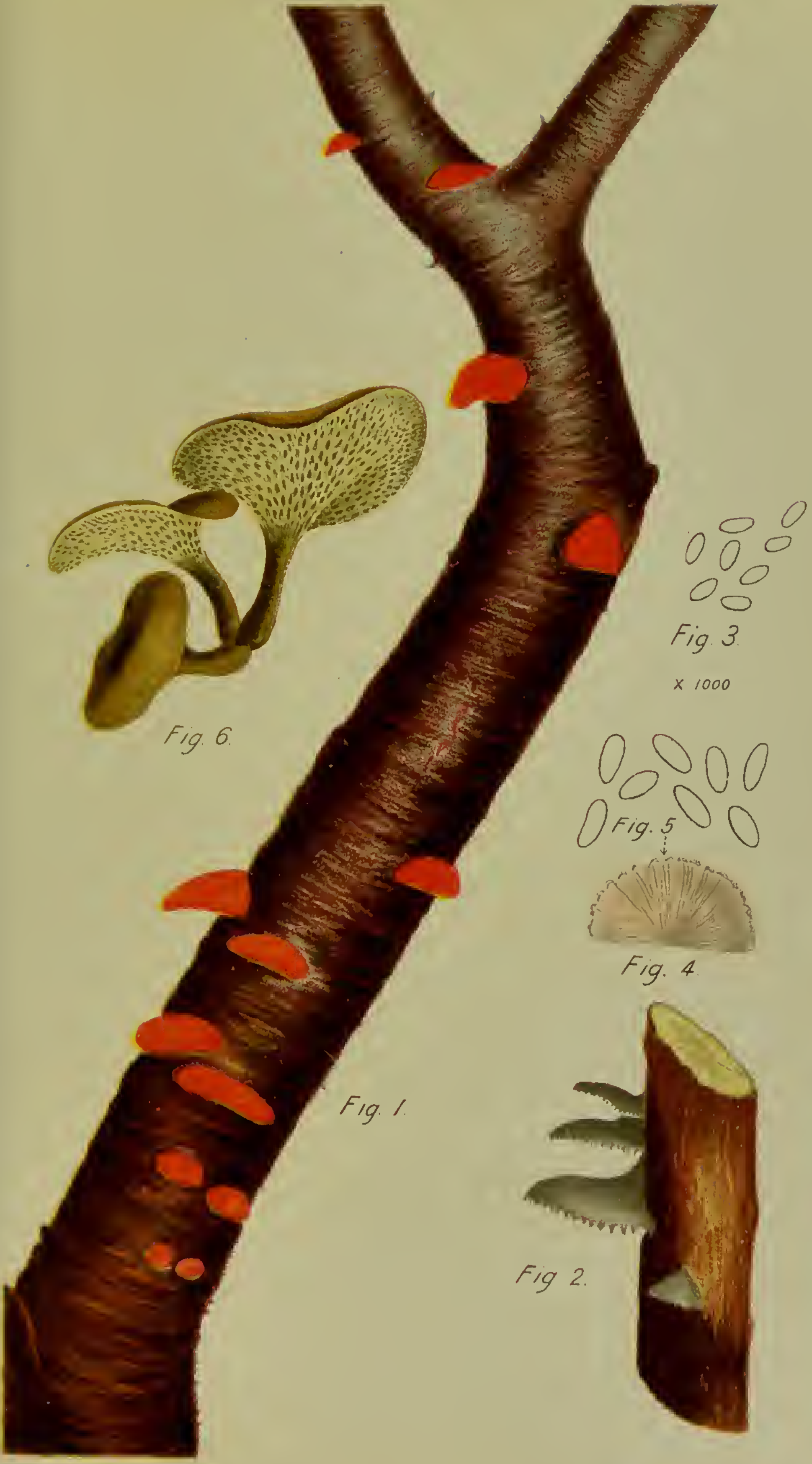
Fig. 6.
Fig. 3.
x 1000
Fig. 5
Fig. 4.
Fig. 1.
Fig 2.

6. BARK ROT.

(*Polystictus cinnabarinus.* Fr.)

This vermilion-coloured bracket-like fungus is a very common object on a great variety of trees and also on dead wood. Its bright orange red colour attracts the eye of the most casual observer, and sometimes branches covered with it are preserved as objects of curiosity. It has not, however, hitherto attracted attention as a parasite, and it is in this connexion that I am now treating of it.

I have observed it thickly studding the stems and branches of cherry and apricot trees, sometimes when in full bearing and the fungus was just beginning to injure the bark, at other times when the tree is almost killed by it, or even actually dead. The specimen figured is an old apricot tree which still retained a certain amount of vitality, but the stem and branches where the fungus occurred had the bark all rotted. The mycelium spread in extensive patches underneath the bark, sometimes forming a felted mass like chamois leather. The brightly coloured spore-bearing portion ruptured the bark, appearing sometimes in long irregular patches or in the usual form of a bracket. The bark becomes just, a brown decomposed mass, and the tree is gradually killed. The sporophores occurred on the south-west side of the stem and branches, as this is the side which is most uniformly moist throughout the year, the north side being that from which the hot winds come. In June the spores are produced in abundance, and are readily caught by placing a slide smeared with glycerine at the opening of the tubes.

In the decomposed bark a grub was found of a slaty-grey colour, about 1 in. to 1½ in. in length and considered by Mr. French, Government Entomologist, to be a Tineid larva.

The common *Schizophyllum commune* was also very prevalent on the stem and branches, along with the Polystictus fungus or apart from it, but it seemed to be of the nature of a saprophyte.

Host-plants and parts affected.—It occurred on the stems and branches of cherry and apricot trees. Dr. Sorauer records it as occurring in Germany on walnut trees and causing stems and branches to decay. Now that attention is called to it, it will probably be found on other stone-fruit trees.

Effects.—The effects have already been generally described, and ultimately the branches are killed as well as the tree itself.

Fungus causing disease.—This fungus occurs often enough on dead wood, but it is likewise found on living trees, causing the bark to become disorganized and ultimately a brown decomposed mass. It also occurs on living gum trees, and is, no doubt, responsible for the destruction of a deal of useful timber.

Geographic distribution.—It is found in Europe (but not in Britain), India, Ceylon, Sumatra, Siberia, North America, New Zealand, New Guinea, Tasmania, and Australia. It is sufficiently common in all the States of Australia, mostly on dead wood.

Treatment.—When the vermilion-coloured bracket-like fungus appears on the surface, the mycelium has already disorganized the tissues and rotted the bark. Preventive measures must therefore be adopted.

1. As these parasites obtain an entrance inside the tree through wounds, care must be taken not to injure the bark in any way in the course of cultivation.

2. Where intentional wounds are produced, as in pruning, the necessary precautions must be taken to prevent wound parasites getting in.

3. All decaying or dead wood should be removed, since it might harbor the parasite which would pass over to the growing trees.

4. Since the bracket-like portion of the fungus carries the spores, all such should be removed and burnt, to prevent the spread of the spores. (Pls. IX. and X.)

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PLATE XI.

Gumming.

Fig.

1. Photograph of Apricot tree four years old, showing exudations of gum, death of twigs, and partial defoliation.

This tree was one of several which in the spring of 1894 lost nearly all leaves from one branch to the left, which was followed by slight gumming on that branch. No treatment was given, but in the winter following a severe pruning. This was followed by rapid growth in the spring of 1895. In the summer of 1895, the leaves began to fall prematurely, accompanied by extensive gum flow and death of twigs. The photo was taken in April, 1895. In the winter it was observed that nearly every branch was discoloured when cut across. The tree was cut hard back, but only 6 inches of sickly growth was made in the spring, before the tree died outright.

G—Gum.

2. Section of two-year-old twig from Fig. 1 (× 2).

A. Concentric rings of "gum-pockets."

B. Medullary rays filled with gum.

A. and B. represent the discoloured area and give a brown appearance to the whole.

3. Section of two-year-old twig from healthy tree (× 2).

PLATE XI.

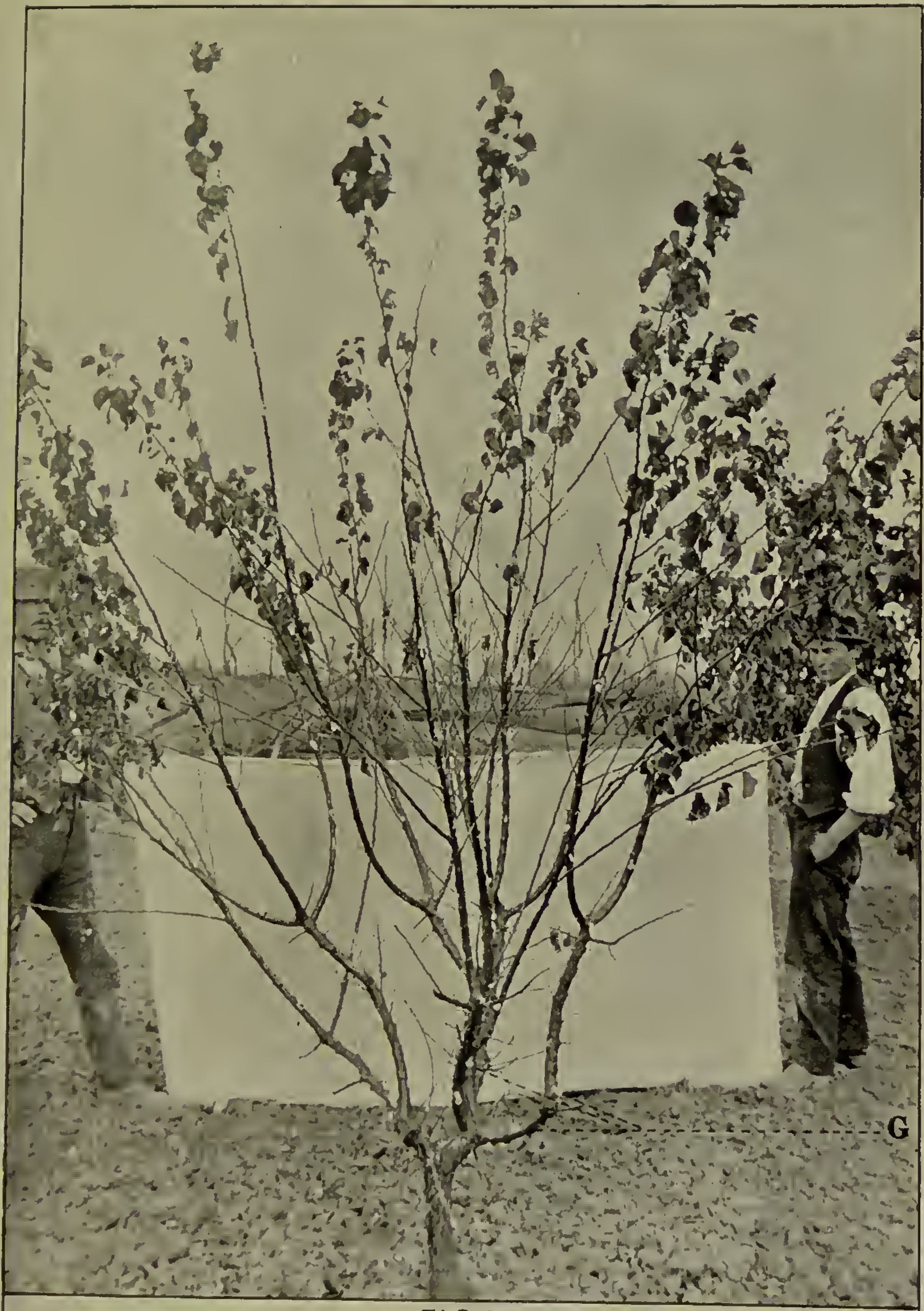

FIG. I.

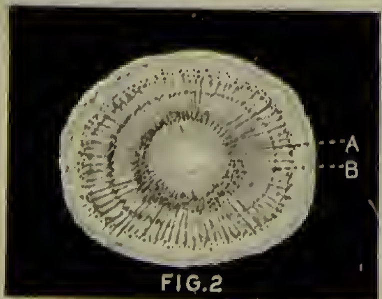

FIG. 2

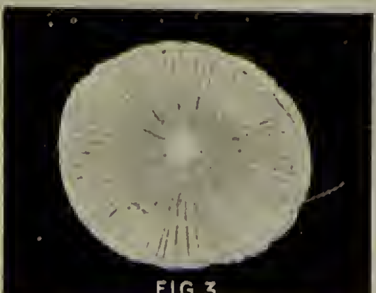

FIG. 3

PLATE XII.

GUMMING.

Fig.

1. Transverse section of young shoot of healthy Apricot (about five weeks' growth) showing starch in sheath (× 50). Stained with Schulze's solution.

2. Diseased shoot, same age, showing commencement of gumming deposits in vessels, and no starch in sheath (× 50). Stained with Schulze's solution.

   This represents the microscopical appearance of the shoots just prior to the gum-flow, and about two weeks after the partial defoliation occurring in the spring.

   S.p.—Starch present in sheath.

   S.a.—Starch absent.

   G.v.—Gum in vessels.

PLATE XII.

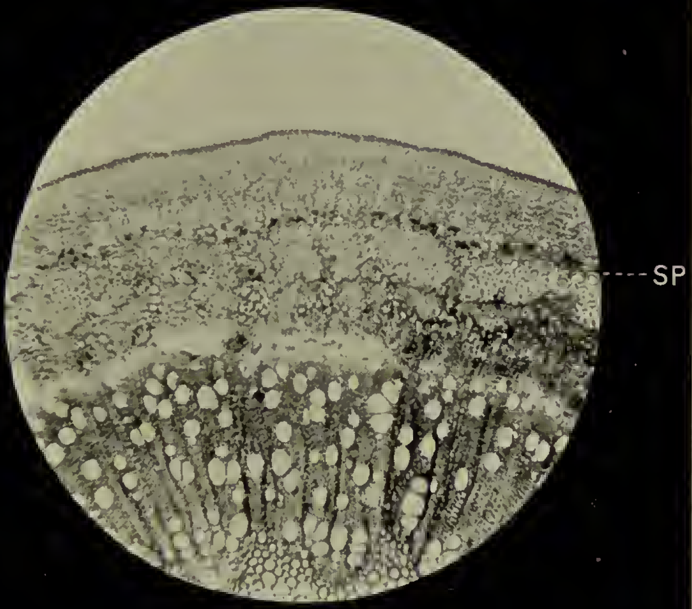

FIG. 1

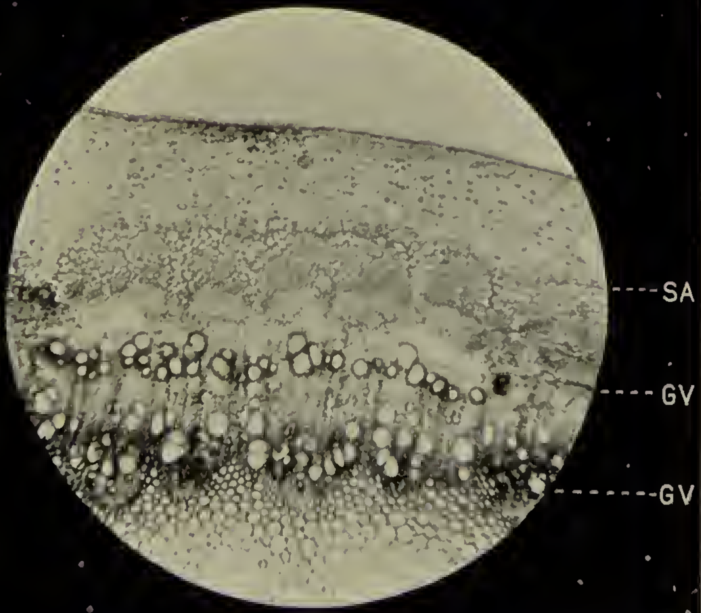

FIG. 2

G. H. ROBINSON, Photo-micro.

PLATE XIII.

GUMMING.

Fig.

1. Transverse section of petiole from healthy shoot of Apricot, showing starch in sheath (× 50).

   S.p.—Starch present in sheath.

2. Transverse section of petiole from diseased shoot, showing comparative absence of starch (× 50).

   S.a.—Starch almost absent from sheath.

   The difference in size is characteristic, and not accidental, and both are from shoots of six weeks' growth.

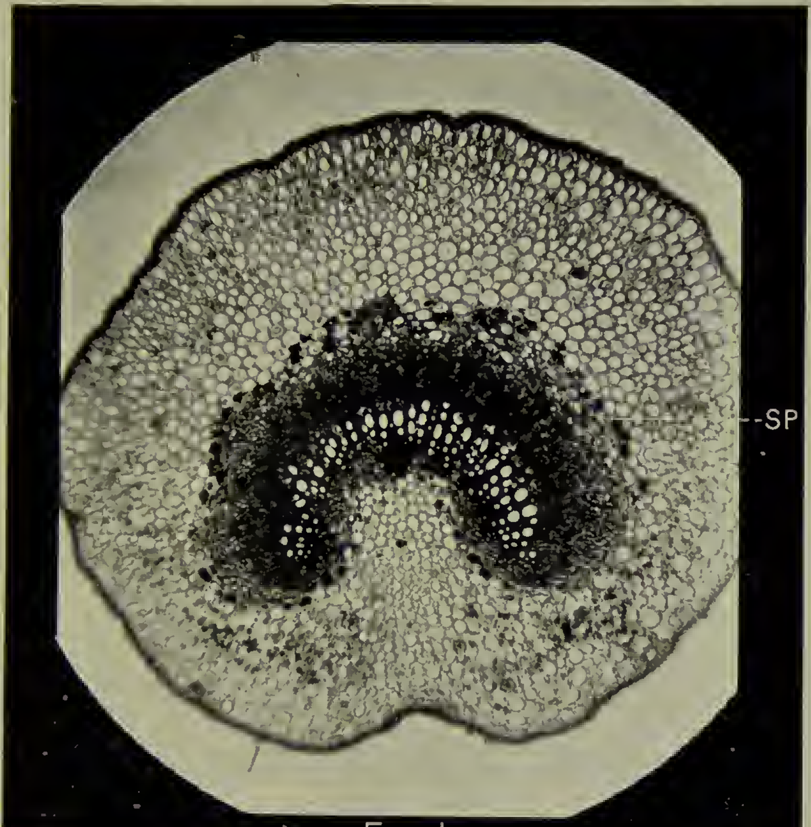

FIG. 1

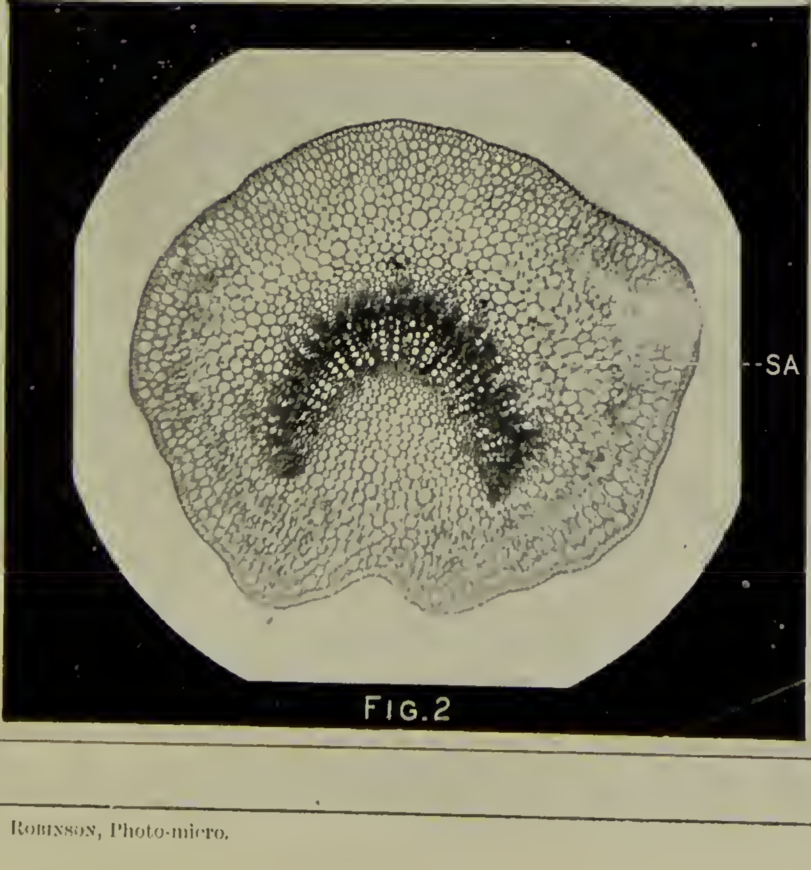

FIG. 2

G. H. ROBINSON, Photo-micro.

PLATE XIV.

Gumming.

Fig.

1. Transverse section of diseased Apricot shoot, of one year's growth, showing deposits in wood vessels, partial replacement of starch by gum in medullary rays, and commencement of formation of gum-pockets (× 100).

2. Transverse section of diseased Apricot branch, of two years' growth, showing deposits in wood vessels, and formation of gum-pockets by the dissolution of the cell walls (× 100).

G.v.—Gum in vessels.

G.m.—Gum in medullary rays.

G.p.—Gum-pockets.

It will be noted that the gum deposits occur nearest the centre of the branch, the gum-pockets originating towards the outside.

PLATE XIV.

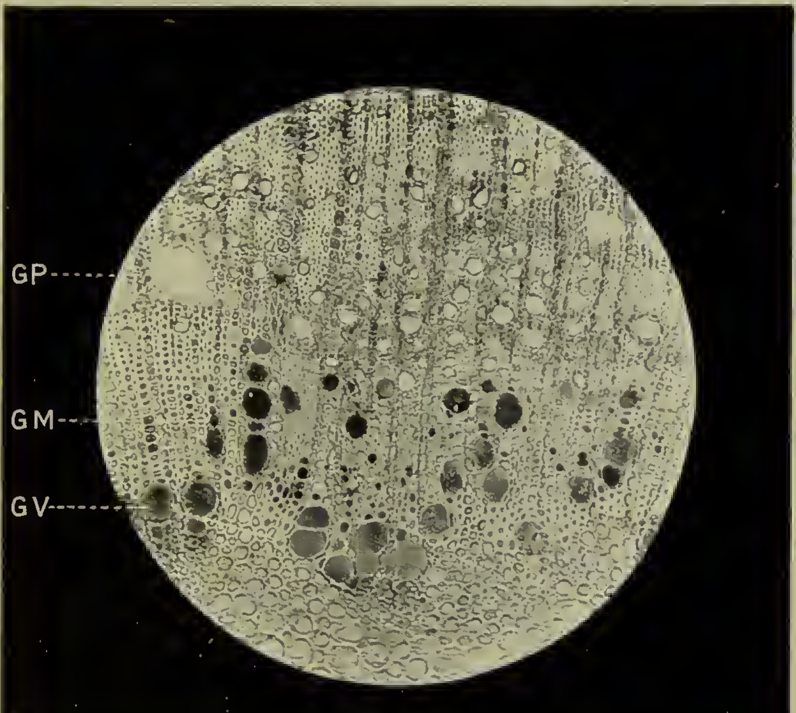

FIG. 1

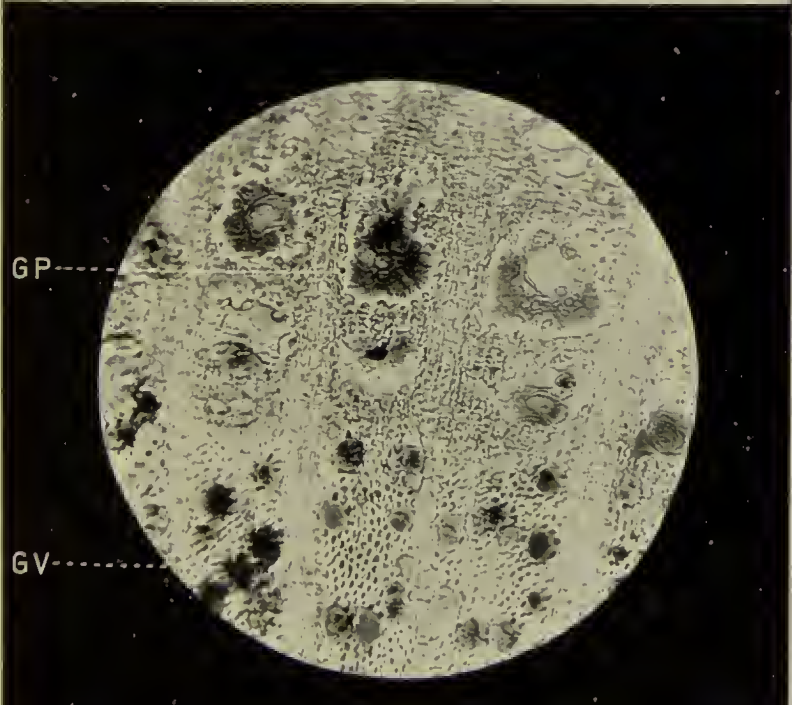

FIG. 2

G. H. ROBINSON, Photo-micro.

7. GUMMING OR GUMMOSIS.

Gumming is a disease common to a number of fruit trees, and is specially prevalent in the genus *Prunus*. During last season, with a cold wet spring, it was particularly bad in some localities, especially among cherry trees.

If a wound occurs from any cause, gum is formed in abundance in the neighbourhood and the wounded surface is thus protected against external injurious influences. This gumming is produced by a degradation or retrogressive metamorphosis, as it is called, of the cell-wall and its contents, particularly the starch grains, and this is supposed to be brought about by the action of a ferment. Such a ferment has not been isolated, nor has its existence been proved, but we know that such degradation products are usually the result of their action.

But while the gum serves to protect a wound externally it may also occur internally without any visible sign of its presence, at least in its early stages. This shows that there has been some derangement in the life of the plant, and that the gumming is due to a want of balance, however caused, between the various nutritive processes. It is therefore very difficult to attribute it to any definite cause, and generally speaking preventive measures which aim at removing the different disturbing factors will be the best. Suitability of soil and climate to the particular variety of tree grown and proper cultivation, manuring, and drainage will go a long way to minimize the evil.

Symptoms.—Generally on the stem or branches, occasionally on the leaf-stalk, but often on the fruit, the well-known gummy masses occur. At first they are of a glassy transparency and soft, but subsequently they become amber-coloured or brown, and harden. They are in the form of drops or "tears," or may become large shapeless sticky masses, or may even form a thin transparent coating over the surface.

This gum, which usually exudes from the fissures of the bark of stone-fruit trees, is known as cherry-gum (Cerasin), and swells up in water, while in alcohol it neither swells nor dissolves.

Causes and Effects.—Gumming is associated with a variety of conditions of the plant, but it is often difficult, if not impossible, to attribute it to any one cause, hence the difficulty of dealing with it.

The gum usually exudes from a wound, but it may also occur inside the tissues, so that it is only discovered when a section is made. The healthy tree, however, contains no gum pockets, and the gum is a diseased or degradation product formed by the decomposition of the tissues.

When the gum appears on the surface it is in the form of masses or drops, but sometimes when the branch of an apparently healthy tree is cut across in the spring, a shining exudation is seen on the cut surface, which ultimately collects into drops. This is the beginning of the process of gummification, and it may go on in various tissues to such an extent that they are partially or entirely replaced by gum.

It is evident from this that it depends on the tissue in which the process starts, when the gum will reach the surface. If in the bark then all the sooner, but, if in the wood, then it may take a considerable time to reach the surface. Sooner or later, however, the cambium or wood will be attacked, and then the increase in growth and thickness is stopped in that particular part.

This may also serve to explain the apparently sudden appearance of gumming for some trees, for it may have been going on in some tissue outside the cambium for several years without any external indications.

In order to determine the probable cause of gumming in any particular case it will be necessary to make a section of the stem or branches and see how the tissues are affected. This will probably reveal the fact that it may result from a variety of causes, the collective effect of which is to derange the normal nutrition of the tree and produce gumming.

Among the various causes which have been assigned, the following may be mentioned:—

1. Fungi.
2. Bacteria.
3. Insect punctures.
4. Galls at the root.
5. Atmospheric conditions, such as frost, excessive rainfall, &c.
6. Any unfavorable conditions reducing vitality of plant, such as deep planting, want of drainage, manuring liberally but leaving out essential constituent, &c.
7. Severe pruning.

The main cause of gumming is wounds, and these may be produced in various ways, by the punctures of insects, severe pruning, and the gnawing of the bark by hares. When, however, these are not associated with other unfavorable conditions, the damage resulting is but slight, and the tissues may often be caused to heal by merely cleaning the wounds with a sharp knife; dry weather being chosen for the operation.

Whatever interferes with the proper action of the root, whether it be unsuitable soil or the action of galls, may also cause it; and any unfavorable conditions which tend to reduce the vitality of the plant, and which interfere with the normal nutrition, may cause such a disturbance as will result in gumming.

The action of fungi, bacteria, and atmospheric conditions, such as frost, will now be considered in special cases.

1. *Fungi.*—In investigating the diseases of stone-fruit trees I found quite a number of fungi associated with gumming, but there was no evidence as to their being the cause. Massee claims to have proved for the first time that gummosis may be caused by a fungus in the case of *Prunus japonica*, Thunb. He has named it *Cladosporium epiphyllum* Fr., and a stage in its life-history corresponds to *Dematium pullulans*, De Bary, which was found in Victoria on all the stone-fruit trees. He states that the exudation of gum is entirely due to the action of the fungus, and repeated experiments with pure cultures of the various stages of the fungus prove that it is a wound-parasite, gaining entrance into the tissues through small wounds in the bark, broken branchlets, and more particularly at those points where leaf-buds or flower-buds were broken off by birds.

The preventive measures recommended are the removal of dead branches, or better still, collar-pruning should be resorted to. A gum-disease of orange and lemon trees, known as "collar-rot," and called by Italians "Mal-di-gomma," is associated with *Fusarium limonis*, Briosi, which is probably the cause of it.

Coryneum Beyerinckii, Oud., is said to cause gumming on stone-fruit trees, and is considered in connexion with *Clasterosporium carpophilum*, with which it is regarded as identical.

2. *Bacteria.*—There is a serious disease of the vine, in Italy, known as "Mal nero," and called by Prillieux and Delacroix "La gommose bacillaire de la vigne." The wood, when attacked, exhibits black points, which rapidly coalesce and cause the tissues to decay. A brown gummy substance was found in all the diseased elements, containing numerous bacteria of the form *Leptothrix.* When healthy vines were inoculated the disease was produced the following year, showing that bacteria probably caused the disease.

Frost.—In the drier inland districts of Victoria during the early spring the leaves of the apricot are often observed to fall suddenly from one or more main branches, leaving the young shoots quite bare except for their extreme tips. Though these shoots rarely die outright growth is severely checked if not entirely stopped. About two weeks after this defoliation, the first indications of gum deposits can be detected in the petioles of the leaves, in the shoots, and the older wood of the affected branches in sections examined under the microscope (Plates XII., XIII.). A few days later the gum begins to exude from numerous points along these branches, though the remainder of the tree appears quite healthy. By midsummer the diseased branches may be quite dead, though more frequently remaining alive till the following season, when death generally occurs. During the winter the affected branches when cut across appear brown and discoloured due to the presence of gum deposits and formation of pockets.

From Plates XI., XII., XIII., and XIV. some idea of the changes occurring in the diseased branches may be gathered. The first noticeable feature, occurring about two weeks after the defoliation, is the almost complete absence of starch in the sheath of the young shoots and the petioles of the few remaining leaves. Occasionally, minute particles of gum may be found replacing the starch, and at the same time the first trace of gum appears in the wood vessels. A gradually-increasing proportion of the starch in the medullary rays becomes replaced by gum, the wood vessels slowly become clogged with the deposits, and, lastly, the formation of gum pockets begins in the younger or outer wood from the disorganization of the cell walls.

Spring frosts are held to be the immediate cause of the trouble, though probably other contributory factors must be present, such as excessive wet, possibly followed by drought, or a hard dry subsoil, or surface rooting. These conditions are unfortunately only too common in irrigated districts, and are often difficult to control.

Treatment.—If the limbs which have lost their leaves are promptly shortened back, and the bark split with a sharp knife down to the trunk, the gum flow may be almost entirely prevented, the degree of success depending largely upon the promptitude with which this is done after the first danger signal—the fall of the leaves. The primary object of the treatment is to prevent the deposit of gum in the vessels, which, if extensive, is followed by the disorganization of cell walls and formation of gum pockets, conditions always serious and generally fatal to the branch, or even to the whole tree. Even when the gum flow is extensive, relief may often be afforded by the adoption of these measures. In the pruning season all discoloured wood should be rigorously cut away, for not only is it useless to expect healthy growth from it, but it is a source of positive danger to the rest of the tree. In several cases under observation trees subjected to no special treatment died outright in about two years, while very numerous cases have been successfully treated in the manner here indicated.

Plate XI. represents a tree eighteen months after the commencement of the disease, and six months after the photo was taken it was completely dead.

Selby refers to a twig disease of the peach in Ohio with gum flow. There is a copious gumming of twigs, branches, and even of the trunks, and the exuded gum hardens and becomes conspicuous. The trouble prevails at all seasons, but is most manifest when the leaves are off the tree. The exudation of gum generally occurs near the leaf-scars of the previous season on the young growth. Enlargements take place at affected spots, owing to the continued exudation of the gum, and are so conspicuous sometimes as to be mistaken for Black-knot. The fruit-bearing capacity of the trees is impaired, and much of the fruit is worthless, owing to gum-pockets inside and exuded gum upon the surface. Although the trees are not soon killed, yet the ultimate effect must be to shorten their lives. I have not met with this particular form of disease in Australia.

Selby does not consider the gumming as a cause, but rather the result of the disease, and while it is possible that some bacterial organism may be concerned in it, although he failed to secure cultures, he inclines to the view that " some impairment of vigour or interference with normal life activities seem to afford a partial, if not a complete, explanation of cause." The fact, however, that this form of gumming may be transferred from one tree or fruit to another by inoculation seems to support the view that, in this case at least, some pathogenic organism is concerned in the process.

Treatment.—From the cause of the disease being so obscure and uncertain in most cases, it is only in a general way that treatment can be recommended.

According to Frank, gumming is not a specific disease, but a symptom of a diseased condition which may have very various causes. Tubeuf considers that the disease is primarily due to errors in cultivation, and that bacteria, when found, are only of secondary importance.

Where the disease is purely local, local treatment may be resorted to by removing the gumming mass and closing the wound, but this is at best a temporary expedient. It is recommended to cut away the wounded portion into the sound wood, and then treat the part with a 50 per cent. solution of acetic acid, keeping it damp with the same acid for some days, or even weeks. Or it may be treated with two parts Stockholm tar and one part carbolic acid. These methods are only practicable where a few trees have to be dealt with, but preventive treatment will be found the best.

In a general way, since gumming is only a symptom of some other diseased condition, it can only be cured by preventing the conditions which called it forth. See that adequate nourishment is provided, that the trees are planted in suitable soil, and guard against wounds of any description.

The following recommendations are of general application; special directions for particular cases have already been given :—

1. Attend to tillage, drainage, and manuring, and see that plenty of lime is supplied, which reduces the tendency to gumming.

2. Avoid deep planting and extremes of wet and drought where an artificial supply of water is available.

Opinions of Growers.—Mr. Lenne, of Ardmona, remarks that "gumming on apricot trees is not very frequent. In ordinary positions in the orchard not more than a half per cent. is affected. Mostly, then, one or two branches of the tree die off, but if they are pruned in winter time back to the sound wood or close to the stem, and the remainder of the branches cut severely back to get a crown as equal as possible, the tree will be equal in size to the others in a year or two. Near water channels or in wet places they are much more affected if worked on their own roots, but if worked on cherry plums or myrobalan, they can stand the water all right, and will make in such places larger trees, and bear better than those worked on apricot stocks."

As regards cherry trees, which are much affected by gumming after they are six or seven years planted, he remarks—"I tried every way of pruning, and sealed every larger cut with tree wax, but to no purpose. If not pruned at all some of the spurs die back and gum. The only varieties which do not suffer so badly are Bedford Prolific and Florance; all others suffer badly."

Almond trees gum if they are planted near a water channel or in a wet place.

Mr. Ratcliffe, also of Ardmona, writes—"I have had scarcely any 'gumming,' and have never lost a tree with it, though I have on several occasions noticed a small apricot branch die off, but nothing serious. Early last spring I saw several apricots in neighbouring orchards die out completely with the disease; the trees seemed to go off in a day or two. Most of my apricots are on peach stocks, and do very well, making fine growth and giving good crops. The trees that I noticed die off were on apricot stocks."

Mr. Goodman, of Bairnsdale, remarks that "cherries do not gum much unless worked on the Mahaleb stocks. If worked on the stock the tree outgrows it and dies when about ten or twelve years old." (Plates XI., XII., XIII., XIV.)

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8. LEAF SCORCH.

The excessive moisture during the past season, followed by heat, has had the effect of making the trees transpire too freely, and this combined with frosts, in some districts, has caused young twigs, together with their leaves, to become shrivelled and burnt. There is a similar disease of the leaves in America known as leaf scorch of the cherry, and described in a recent Bulletin of the New York Agricultural Experiment Station (Bulletin No. 162, November, 1899). The foliage on the trees of all ages were scorched, and more or less of the leaves were brown, shrivelled, and burnt, but the twigs were neither blackened nor shrivelled. Where the soil and conditions were uniform there the trees were uniformly affected, and, as might have been expected, the disease was most severe on trees standing in dry soil. With very few exceptions, the whole leaf was affected, if affected at all, and trees might be attacked on one side or another. The susceptibility of different varieties has not yet been observed.

9. "SPLIT-STONE" OF THE PEACH.

Certain varieties of Peach are liable to a disease, usually termed "Split-stone," a name which sufficiently describes the character of the malady. This condition is not unknown in other parts of the world, though, so far, it has not been ascribed to a fungus. Examination of a considerable number of fruits has revealed the general presence of a new species of mould (*Rhizopus schizans*) occurring in the kernel of affected fruits. Though the fungus may not be the actual cause of the "split-stone," yet it is of some importance, since the rotting of the fruit, which generally ensues, is undoubtedly caused by it. Other species of this genus are associated with rotting, as *R. necans*, Massee, causes the rot of Lily bulbs, and *R. nigricans*, Ehr., causes a soft rot of sweet potato, according to Halsted.

GENERAL REMARKS ON TREATMENT.

It cannot be too frequently or too strongly impressed upon the orchardist that he should use every known means to insure the health and continued productiveness of his trees and thus guard against liability to disease and premature decay. The varieties grown should be adapted to the district, the most suitable stocks should be used, any deficiency in the soil should be made good by manure, and the general cultural operations should promote a healthy growth. As Bailey remarks, in his *Principles of Fruit-growing*—"There are four fundamental operations upon which all permanent success in most kinds of orchard culture depend, and their importance lies in something like the following order:—Tillage, fertilizing, pruning, spraying. Spraying is the last to be understood, but this fact should not obscure the importance of the other three."

The balance between trees and their environment is so delicate and so easily disturbed that one must always be prepared for a departure from the normal or a state of disease, especially in a climate like ours, where sudden changes are so frequent, and this involves the use of special precautions to prevent that as much as possible. Mechanical injuries, climatic conditions, and insect pests, require their own appropriate treatment; but for generally dealing with diseases caused by fungi, the following measures will be found beneficial:—

1. Dead or diseased portions should be removed as soon as possible and burnt. Each diseased portion is a possible source of infection, and should therefore be destroyed by fire. The fructification of the fungus appears sooner or later on such parts, and they should on no account be added to the compost heap.

It may not always be practicable or profitable to rake together and burn diseased and fallen leaves, but they should certainly not be used as a mulch to the tree, as I have sometimes seen done. Clean cultivation is a useful ally in the prevention of disease, and while this is true of fungi generally, it is particularly so in the case of the "shot-hole" fungi. Not only do the fallen and decaying leaves and the scabby rotting fruits harbor the disease, but the dead twigs, even while still attached to the tree, may have spots literally covered with the fructification of the fungus. Any one who has once seen with a magnifying glass the countless myriads of spores on leaf and fruit and branch would cease to be surprised at the prevalence of "shot-hole." Cleanliness in the orchard, therefore, is one of the best means of lessening the mischief.

2. Spraying should be regularly practised, and, although there are quite a number of materials in use, yet compounds of copper are at present recognised at the best fungicides, and are most generally applied in the form known as Bordeaux mixture. Spraying has sometimes been described by those who have not practised it as the lazy orchardist's apology, but the thrifty and industrious vignerons of Germany and France are examples to the contrary, for in some districts there is hardly a vineyard which is not regularly sprayed. It is used as a means of prevention, and it is well known that it is much easier to check an epidemic at the start than to overcome it when it is once established

Even if disease does not appear, the effect of the spraying is not lost, for it exercises a manurial action, and increases the effect of any manure that may be applied.

It ought to be clearly understood at the outset that there is no such thing as what some growers call an orthodox Bordeaux mixture, or one in which the proportions of the constituents are rigidly fixed. The proportions most suitable for any given locality are to be found out by trial, and they depend upon the time of applying the spray as well as the humidity or dryness of the atmosphere. Generally speaking, the greater the proportion of lime, the greater the adhesive power, and the smaller the proportion of lime to the bluestone, provided the mixture is safe, the greater the efficacy of the spray. Hence, if the spray is applied immediately before the opening of the buds, and required to act at once, then less lime would be added than if it were applied earlier, and had to withstand the weather.

The best results were obtained in the United States from 5 lbs. sulphate of copper, 5 lbs. lime, and 45 gallons water, but the amount of the first two constituents, or, in other words, the strength of the mixture will vary according to locality, &c., and should be determined by judicious tests. In making experiments based on American formulas, it should be remembered that the weight of the gallon there is only 8·345 lbs. as against 10 lbs. in Britain, so that a smaller proportion of water than the figures would seem to indicate is really employed. About 40 gallons of water may be used instead of 45.

Sprays adapted for wet and dry localities.—While ordinary Bordeaux mixture may be generally used, it is evidently desirable in a wet climate to increase the adhesive power of the mixture, and this may be done in various ways.

(*a*) It is known that lime increases the adhesive power of a fungicide, and therefore an increase of lime while maintaining the relative proportions between it and the sulphate of copper, or, in other words, a stronger mixture, will prove more enduring. In a wet locality, the conditions are usually favorable to the development of fungus disease, and this stronger mixture, while more adhesive, will also be more active on dormant trees. Under such circumstances, the best results are likely to be obtained by even doubling the proportions, and using 10 lbs. lime and 10 lbs. sulphate of copper to 50 gallons of water, the equal proportions of lime and bluestone still being maintained. In some localities the application of the Bordeaux mixture did not give such favorable results as that which was rendered more adhesive during the past season, the long wet winter and the excessive moisture causing evaporation from the soil later on, and thus tending to remove the mixture before producing its full effects.

(*b*) By adding an equivalent of molasses to the mixture, the adhesiveness is increased, and incidentally the cost.

(*c*) Soft soap added in equal proportions with the bluestone likewise makes the mixture adhere better. The soap increases the tendency of the liquid to spread and not to gather in large drops. The addition of hard soap or linseed oil (raw or boiled) also makes the mixture extremely adherent.

(*d*) By adding acetic acid or vinegar, it forms acetate of copper, which on exposure to the atmosphere is converted into verdigris, a substance insoluble in water, and this adheres firmly to the tree. The orchardist can easily and cheaply provide himself with acetic acid, since it can be obtained from the fermentation of windfalls or inferior apples.

Not only should the strength of the mixture be increased in a wet climate, but a second winter spraying should be given when the trees are dormant, to make sure of its proper action.

In experiments with a number of substances for spraying potato-plants to test the action of rain upon them, it was found that the ordinary Bordeaux mixture with 2 per cent. of treacle added had by far the best resisting power, only 11·2 being removed, and neither heavy nor light rain having much effect.

Quite a number of substances have been used along with the Bordeaux mixture in addition to sugar or molasses, soap, vinegar, sal ammoniac, whiting, &c., and there is still room for a variety of experiments to be tried under our special conditions. Sulphate of iron, or green vitriol, is a well-known remedy for the green-sickness or chlorosis of the leaf, and it has been tried, dissolved along with the copper salts. The Bordeaux mixture has also been used as an agent for emulsifying kerosene, apparently with satisfactory results.

The Copper-soda or Burgundy mixture may be employed in place of Bordeaux mixture. This spray has recently come into favour on account of its good adhesive properties and easy preparation, while it is much less severe on the hands of the workmen. For winter spraying it has the drawback that after drying upon the tree it is not easy to say whether the spraying has been thoroughly done, though the absence of any considerable deposit is an advantage in treating ripening fruit. Experiments are being conducted to find a suitable medium to add to the mixture which will leave a considerable adhesive deposit on drying. Whiting at the rate of 1 or 2 lbs. to 50 gallons of spray is worthy of trial.

Time for Winter Spraying.—This will be determined by the time of the germination of the spore. A spore from its very nature is well protected against external influences during the winter, but it is well known that just when it is about to germinate or has germinated, then it is most easily destroyed by fungicides. This happens about the time when the young leaf-buds are about to burst forth, and the tissues are in the most delicate and susceptible condition for infection. Therefore, the spray should be applied just before or at the opening of the buds. When two winter sprayings are given the first should be made a few weeks before this.

It may happen that, for various reasons, another spraying is necessary after the leaves unfold, although ordinarily a single spraying done thoroughly and at the proper time will control the most severe attacks. The 40-gallon formula may still be used—5 lbs. bluestone and 5 lbs. lime—when the leaves are about half grown. And even if late sprayings should be necessary to protect the fruit without discolouring it, then the copper carbonate or copper soda solutions may be used as given in the chart at the end.

Mode of Applying Spray.—It must be thorough, in order that the liquid may reach every portion of the tree, for the spores lie everywhere in wait upon the tree ready to attack the young and succulent leaf-buds, and any unsprayed portion is a likely source of infection.

In order that the spray may be equally distributed, calm weather should be chosen, and the twigs should be dry, so that the mixture may not collect in patches.

It is sometimes stated that twigs or buds are injured by the spray, but, if properly prepared and applied before the opening of the buds, there is no danger. Well made Bordeaux mixture may be safely used even as late as the opening of the first blossom-buds.

In orchards where the disease has been neglected for some time, the soil may become saturated with the germs of the disease, as they are so numerous, so light, and so easily distributed by the wind, that unless kept in check, they will gradually overspread the soil of the orchard. Hence the advice to spray the soil as well as the trees will probably yield the best results and reduce to a minimum possible sources of infection.

The necessity of spraying is often only forced upon the grower when his crop is all but ruined and the trees have suffered severely in vigour and constitution from repeated attacks of disease. At its very first appearance the disease should be taken in hand and preventive measures adopted, for then it is most easily and most effectually controlled. But in order to do this, the grower must not only have enthusiasm but knowledge, and a publication like this should help him in understanding the nature of fungus pests, and the mode of their attack. He may not know all about the philosophy of spraying, but he will have a definite object in view when he directs his spray against some well understood foe and is not merely fighting in the dark. It is intended to act as a poison to the germ, which initiates the mischief; as a protection to the tree against further attack; and as a stimulant to healthy growth, the foliage of the sprayed trees being usually much brighter and more luxuriant than that of the unsprayed; while the production of a good supply of fruit-buds for the ensuing season may be seriously interfered with if the trees are not properly sprayed at the right time.

THE PRINCIPAL FUNGUS DISEASES OF STONE FRUIT TREES AND THEIR TREATMENT.

DISEASE.	PLANT AND PARTS ATTACKED.	SYMPTOMS.	PREVENTATIVE AND BENEFICIAL MEASURES.			REMARKS.
			GENERAL.	FIRST SPRAY.	SECOND SPRAY.	
Leaf Curl	Peach—Leaves and shoots	Swollen, distorted, often bright-coloured leaves	In pruning season cut out and burn diseased shoots	Bordeaux Mixture just before blossom buds open	... ...	In wet districts or situations specially liable to the disease it will be found advisable to spray twice in the winter, first about the end of July, second about a week before blossoming. Spraying after the leaves are out is of little or no value.
Shot Hole and Scab	Apricot Almond Peach Plum Cherry Leaf, fruit, and shoot	*Brownish* or greyish spots on leaves, soon falling out; *Brown* or black scabs on fruit; *rounded* sunken patches on shoots, sometimes accompanied by gumming	In pruning season cut away dead or seriously diseased shoots	Bordeaux Mixture just before blossom buds open	Bordeaux Mixture after fruit has set	The second spraying may be found necessary in wet seasons, and the rule to be observed is to do the work as early as possible, since the fungi concerned find the most favorable conditions for their spread in the early spring, when the air is moist and the leaves are young and tender.
Rust	Peach—Leaf, fruit, and twig Plum—Leaf	Yellowish spots and patches on upper surface of leaf, brownish powdery points on lower	Destroy all diseased fruits and shoots ...	Bordeaux Mixture before blossom expands	... ...	It may be found necessary in wet seasons or moist localities to give further sprayings.
Brown Rot or Twig Blight ..	Peach—Fruit and shoots	Brown Rot of ripe fruit. Death of twigs and falling of recently-set fruit	Destroy all diseased or dead twigs and rotten fruit	Bordeaux Mixture before blossom opens	Bordeaux Mixture after fruit has set	
Peach Freckle	Peach—Fruit, leaves, and twigs	Numerous black spots on fruit as well as leaves and twigs	Destroy all diseased fruit	Bordeaux Mixture before blossom opens	Bordeaux Mixture after fruit has set	

BORDEAUX MIXTURE.

Copper sulphate (bluestone)	...	5 lbs.
Quicklime (to be freshly slaked)		5 lbs.
Water	...	40 gallons

Pulverize the bluestone and dissolve it in a wooden vessel containing half the quantity of water or 50 gallons. This can be simply done by tying the bluestone in a coarse sack, and suspending it just beneath the surface of the water by means of a stick laid across the top of the wooden vessel.

Slake the lime in a small quantity of water so as to get it as fine as possible, then add the remaining 50 gallons of water.

When cool, pour the milk of lime and copper solution slowly together into a barrel holding 100 gallons. The milk of lime should also be thoroughly agitated before and while pouring it out; and the mixture in the barrel should also be thoroughly stirred for several minutes.

To determine whether the mixture is safe to use on tender foliage, insert the blade of a penknife into it for at least a minute, and if copper is deposited on the steel more lime must be added until there is no deposit of copper.

Use the Bordeaux Mixture immediately after it is made.

Air-slaked lime should never be used in preparing Bordeaux Mixture, as the leaves are likely to be burnt.

By adding soft soap or treacle to the mixture equal in quantity to the bluestone used its adhesive property is increased.

Two quarts of the following resin solution may be added to 40 gallons of Bordeaux for a similar purpose:—

Resin	...	2 lbs.
Crystallized sal-soda ...	...	1 lb.
Water	...	2 qts.

BORDEAUX MIXTURE AND OIL.

Take from 3 to 6 fluid ounces of Linseed Oil (raw or boiled), and pour on to the lime when in full ebullition in the process of slaking. This is perhaps the most adhesive form of Bordeaux Mixture.

COPPER SODA OR BURGUNDY MIXTURE.

Washing Soda ...	...	8 lbs.
Bluestone	...	6 lbs.
Water	...	40–50 gallons

Dissolve each separately in half of the water, and pour the dilute solutions together.

BLUESTONE SOLUTION.

Bluestone	...	1 lb.
Water	...	25 gallons

(For winter use only.)

AMMONIACAL COPPER CARBONATE.

Copper carbonate	...	5 ozs.
Ammonia (26°)	...	3 pints
Water... ...	...	45 to 50 gallons

Mix the copper carbonate in a wooden pail with sufficient water to make a thick paste, next add the ammonia to dissolve the paste, and when all is dissolved dilute with water to make 45 or 50 gallons.

PART II.—TECHNICAL DESCRIPTIONS OF FUNGI.

INTRODUCTORY.

I have followed the same general plan as in the "Diseases of Citrus Trees," and devoted the first part to a general account of the principal fungi causing disease, suited to the requirements of the ordinary grower, while the second part gives a technical description of the various fungi found upon stone-fruit trees whether parasitic or not. This will enable the earnest student of Plant Diseases (and all those whose duty it is to instruct growers should come under this category) not to trust merely to superficial appearances, which are often misleading, but to determine the true cause of the disease, and thus be able to recommend precautionary or preventive measures.

The fungi are further arranged according to their occurrence on root or stem, leaf or fruit ; but while this arrangement has a certain convenience it has also many drawbacks. It is very convenient to the grower to locate a disease from the part of the plant on which it occurs and the symptoms exhibited there, but where a number of fungi are concerned this is apt to be misleading. The more we study parasitic fungi, the more it is impressed upon us that they are able to accommodate themselves to their surroundings and prey upon different parts of the same plant at different seasons of the year. And here in Australia at least it is generally found that a fungus which is noticed particularly on the fruit will usually be found on other parts as well, such as the leaves and shoots. The peach-leaf rust, for instance, which is generally regarded as a leaf-parasite, also occurs here on the stems and fruits. However, their appearance is often more pronounced on one part than another, and they are placed under that heading simply as a matter of convenience and on account of their common occurrence.

One hundred and fifteen species of fungi are here recorded, many of which are new to science, and such an enumeration will serve to show what an extensive fungus-flora may flourish even on the cultivated species of a single genus (*Prunus*).

FRUIT DISEASES.

The diseases which attack the fruit are considered the most serious by the grower, because they affect that product which gives him a return for his labour. But there may be much more serious diseases overlooked by him, owing to the fact that they do not directly appear upon and destroy the fruit, but rather undermine the health and vigour of the tree so that its fruit-bearing capacity is reduced. Of such are the diseases of branches and leaves, the result of which is that the wood formed is poor in character, less able to resist the action of frosts, and only fitted to bear an indifferent crop of fruit the following season.

The point, however, on which I wish to lay stress here is this, that the fungi which prey upon the fruit generally appear on other parts of the plant before the fruit is formed, and so must receive attention if they are to be effectually dealt with before that stage of their development is reached. The peach freckle or scab, for example, is supposed to be confined to the fruit, but the fungus causing it also occurs upon the leaf and passes the winter in the twigs. The brown rot or ripe rot of the fruit too, is another disease only noticed in the fruit, but it likewise affects and destroys the twigs, causing what is known as twig-blight. And even the peach-leaf rust affects the fruit as well as the branches.

It will be evident from these examples that treatment must not only be directed against the fruit when the disease occurs there, but that it must often begin at an earlier stage, even before there are any leaves on the tree.

I.—Fungi on Fruits (20).

1. Rhizopus schizans.
2. Phyllosticta vulgaris var. cerasi.
3. Coniothyrium pruni.
4. Monilia fructigena.
5. Monilia laxa.
6. Verticillium lateritium.
7. Cephalosporium fructigenum.
8. Aspergillus glaucus.
9. Penicillium glaucum.
10. Trichothecium roseum.
11. Dematium pullulans.
12. Cladosporium carpophilum.
13. Clasterosporium carpophilum.
14. Macrosporium epicarpium.
15. Epicoccum fructigenum.
16. Rhizopus nigricans.
17. Phyllosticta prunicola.
18. Fusarium prunorum.
19. Fusarium putaminum.
20. Ovularia cerasi.

1. *Rhizopus schizans.* N. sp.

Sterile hyphæ creeping and forming a dense felt of delicate, slender hyaline, septate and branched filaments agglutinated together and passing into the coloured swollen root-like portions.

Sporangiferous hyphæ fasciculate, simple, occasionally branched and then 1-septate, clear yellowish-brown, variable in length, reaching 1 mm. in length and 17μ thick, arising from creeping stolons similarly coloured. Sporangia globose, dark-brown, smooth, about 150μ diameter; columella elliptic (70 × 52μ).

Spores dark-brown in mass, pallid individually, elliptical to oval, average 7–7½ × 5–5½μ. Associated with splitting of stone of peach. Ardmona, Victoria (Robinson 136).

It differs from *R. nigricans*, Ehr., in the shape and size of the spores and in the columella being elliptic.

In nearly every case of split-stone this fungus was found associated with it, and is probably the cause, although it is generally attributed to early frosts. (Figs. 1, 2.)

2. *Phyllosticta vulgaris*, Desm. *var. cerasi.* Sacc.

Forming depressed waxy-looking patches towards apex of fruit, with densely gregarious, often confluent, elevated pustules. Perithecia minute, slightly erumpent, membranaceous, of loosely parenchymatous texture, with distinct pore, pale olivaceous, 120–180μ.

Sporules pale olive to hyaline, elliptic to elongated elliptic, occasionally slightly constricted, 8–11 × 3½-4½μ, sometimes granular, variable in size, average 8 × 4μ.

On ripe cherries and leaves. December, 1900. Near Melbourne.

This fungus seems to approach nearest to the above, hitherto only found on leaves of cherry. The spots where it occurs are decaying, and the sporules when mature are dilute olive. (Figs. 3, 4.)

3. *Coniothyrium pruni.* N. sp.

Spots on leaf round to irregular, dirty-grey, with raised dark-red margin, afterwards falling away and leaving "shot-holes" or gradually decaying; also on fruit. Perithecia on both surfaces of leaf, but mostly on upper, scattered, minute, punctiform, black, dark ruddy-brown by transmitted light, slightly erumpent, globose, membranaceous, with round apical pore, 130–180μ diameter.

Sporules dark-brown at maturity, globose to shortly elliptical, thick-walled, 6½–8μ diameter, or 9–11 × 5-6μ.

On ripe apricots kept damp. January, 1899. Armadale, near Melbourne.

On plum and apricot leaves. January–March, 1901. Ardmona.

On plum leaves. March and April, 1901. Armadale.

The fruit of the apricot was ripe when plucked, and kept moist for about a week under a bell-jar. Then a profuse development of *Fusarium putaminum*, Thuem., took place, and on portions where a pale fawn skin was formed, the perithecia were developed.

The plum and apricot leaves from Ardmona were kept moist under a bell-jar for about seven days before the development of the perithecia, while those from Armadale were plucked from the trees and showed distinct "shot-holes." (Figs. 5, 6.)

4. *Monilia fructigena.* Pers.

Tufts compact, pulvinate, often confluent, and forming concentric rings.

Hyphæ fasciculate with short branchlets, bearing long chains of conidia often variously branched. Conidia ovoid-oblong or lemon-shaped, at first hyaline, then ruddy-brown 19–26 × 11–19μ, average breadth 12–15μ.

On fruit of peach, apricot, and cherry. Victoria. South Australia.

On apricots. January, 1896. Burnley, near Melbourne.

On peaches. April, 1899. Burnley, near Melbourne.

On cherries. South Australia.

The peaches attacked were soft, disfigured, and rotten mainly on one side, generally of a purplish-brown colour, with white woolly tufts, confluent, and often somewhat circular, becoming pinkish. (Figs. 7, 8.)

5. *Monilia laxa.* Sacc. and Vogl.

Hyphæ hyaline, rigid, septate, branching frequently and in a dichotomous manner, with finely granular contents, and often vacuolated, averaging 4–5 μ broad; branchlets as broad as the main hyphæ, and at first only sparingly septate.

Conidia terminal, hyaline, with finely granular contents, at first globular, then oval to elliptical, 7½–8½ × 4½–6 μ.

On still green, half-grown, scabby apricots. December, 1898. Armadale, near Melbourne.

The scab is permeated by the hyphæ, which form an extensive branching system.

Clasterosporium carpophilum and *Phyllosticta prunicola* were also associated with the scabbing. (Figs. 9, 10, 11.)

6. *Verticillium lateritium.* Berk.

Forming broadly effused, velvety, dull brick-red patches.

Sterile hyphæ dense, creeping, septate.

Fertile erect, primary and secondary branches in verticils, the whorls becoming smaller upwards, giving the whole a pyramidal outline.

Conidia, like the hyphæ, faint pale red by transmitted light, pellucid, elliptic oblong, 4–6 × 3 μ.

On almond leaves. December, 1900. Stawell.

On peach fruit. November, 1900. Shepparton.

On plum fruit and leaf. Victoria.

Both leaves and fruit developed this fungus when kept moist under a bell jar.

This species is found in Britain and elsewhere on various decaying vegetable substances. (Figs. 12, 13, 14.)

7. *Cephalosporium fructigenum.* N. sp.

Exudation of gum masks the colour, but it is probably white. Primary hyphæ long, flexuous, hyaline, septate, branched, average 5 μ broad. Branches with branchlets erect, flexuous, sparingly septate, knobbed at tips, and bearing clusters of conidia; conidia may also be borne on minute knobs on primary hyphæ.

Terminal heads of conidia usually oval and variable in size, coloured yellow by iodine, while hyphæ are uncoloured. Conidia hyaline, elliptical, usually bi-guttulate, sticking well together, 5–10 × 2–3 μ.

On unripe fruit of nectarine and intimately associated with *Macrosporium epicarpium.* November, December, 1890. South Australia (Molineux).

It differs from *C. acremonium*, Corda, in the oval and larger heads, in the septate branches, and in the conidia being sometimes twice as long.

The conidia often remain together when detached, appearing as if enclosed in a sac. Sometimes the end of the primary hyphæ may be forked.

Cephalosporium has been found associated with other fungi in the dry rot of potatoes, but it is usually regarded as a saprophyte, and therefore the injury to the fruit of the nectarine is probably initiated by the Macrosporium. (Figs. 15, 16, 17.)

8. *Aspergillus glaucus.* Link.

Forming "Mouldy Core" of apricot.

In the interior of many apricots there is often a white mould, sometimes rather dense, and if placed in a moist chamber it develops minute green spores, which give the whole a sage-green appearance.

This is one of the common green moulds, and it finds an entrance into the young fruit from the stalk end. Not only does it give the fruit in many cases a musty flavour, but it hastens and promotes decay.

The fruit on the tree is destroyed by it sometimes, and on account of the presence of the fungus the fruit is rendered unsaleable in a few days.

9. *Penicillium glaucum.* Link.

On peaches imported from Queensland, November, 1899.

Also on stone fruits generally.

On dead peach twigs on ground, and plum and peach leaves in moist chamber. Ardmona, Victoria.

In all these cases the mould was evidently saprophytic. (Fig. 18.)

10. *Trichothecium roseum.* Link.

Tufts minutely velvety, rather large, often becoming confluent, at first white, then pale rose-coloured. Sterile threads creeping, branched, septate, intricate, white.

Fertile hyphæ erect, short, without septa. Conidia apical, solitary, pyriform, uniseptate, slightly constricted at the septum, pale rose or almost colourless, attached obliquely to narrow apex of conidiophore, 14–20 × 8–12 μ.

On almond, apricot, and peach leaves. Victoria.

On sweet and bitter almonds—both green and shell almonds.

On dried unripe fruit of apricot and peach, also on peach stones and leaf. (Figs. 19, 20.)

11. *Dematium pullulans.* De Bary.

Forming small black sclerotioid body on almond.

Hyphæ at first colourless, branched, septate, with small ellipsoid cells, sprouting from the extremities of short branches or laterally from the hyphæ. Colourless or pale-yellow conidia multiply by budding as in yeast; or may become thick-walled, brown, resting cells, when supplies of food begin to fail. Each brown cell, after resting, may germinate like a conidium. Finally, hyphæ become moniliform, with thick-walled cells of a brown colour, and these may divide longitudinally as well, or the dark-brown cells may form a tubercular mass from which fertile branches proceed. On skin of almond seed. March, 1900. Leongatha Labour Colony.

This is generally considered a stage of *Cladosporium*, but no trace of that fungus was found in connexion with the well developed form on almond.

It is likewise usually regarded as a saprophyte, but Wortmann, in 1898, observed soft, black spots, on the grapes, with a white mealy appearance in the centre. They sometimes covered one side of the grape, and berries in contact were frequently infected. On the diseased spots this fungus occurred, bursting through the epidermis, where the mealy appearance was observed, and producing its germinating conidia at the surface. The disease was rare, although *D. pullulans* itself is common on the berries and all parts of the vine.

This is the first record of it for Australia. (Figs. 21, 22, 23.)

To be read in connexion with description on p. 107 and Notes p. 162.

12. *Cladosporium carpophilum.* Thuem.

Spots orbicular, often confluent, green to black, forming rings.

Hyphæ short, erect, flexuous, continuous or very sparingly septate, occasionally somewhat branched, slender, smoky brown, averaging 85 × 4 μ.

Conidia ovate to elongated fusoid, obtuse at both ends, sometimes truncated, straight, borne singly or tandem at the apex, not or rarely 1-septate, and sometimes slightly constricted at septum, pallid and clear at first, becoming brown, 18–23 × 5–6½ μ.

On ripe peaches. January and February. New South Wales. (Figs. 24, 25.)

13. *Clasterosporium carpophilum.* (Lev.) Aderh.

Synonyms—*C. amygdalearum.* Sacc.
Helminthosporium carpophilum. Lev.

Forming spots on living leaves, also on twigs and fruit.

Spots circular to sub-circular, greyish to ochraceous with dark-red margin on leaf, and forming rounded intensely black patches on fruit.

Tufts on both surfaces of leaf, mostly on upper, punctiform, greyish, ochraceous or olivaceous, often becoming black, also on scabby surface of fruit.

Hyphæ ramifying in tissue or on surface when spot is much decayed.

Conidiophores erect, fasciculate, almost colourless or pale smoky brown, rupturing epidermis, straight or slightly curved, very often with shoulder-like projection, short and simple, averaging 4μ broad, or sparingly branched, septate, attaining on the fruit a length of 41–45μ, and a breadth of 7–9μ.

Conidia fusoid to elongated-elliptical, pale olivaceous to brownish, a-septate to 12-septate, mostly 3-6 septate, not at all or distinctly constricted at septa, very variable in length and breadth, average 45-50 × 13–14μ, but may reach double that length, and be reduced in breadth to 9–11μ.

Cultures were made from young tufts, and after several days it was found that the conidia became more elongated, and usually with a large number of septa, in some cases approaching the narrow elongated Cercospora-type. On almond, apricot, plum, peach and apple. Victoria, South Australia, and New Zealand.

Almond leaf—June, July, August, November, 1900. Myrniong.
April, 1900. Burnley.
December, 1900. Mordialloc.
,, and shoot, November, 1900. South Australia.
Apricot leaf—September, October, November, December, 1900. Armadale.
April, 1901. Edenhope.
,, shoot—February, 1901. Armadale.
,, fruit—December, 1898. Armadale.
December, 1900. Myrniong.
Peach leaf—November, December, 1900; February, May, 1901. Armadale.
February, 1901. Pakenham.
,, shoot—November, 1900; January, 1901; March, 1901. Armadale.
February, 1900. Panton Hill.
August, 1900. Malvern.
November, 1900. South Australia.
November, 1900. Auckland, New Zealand.
,, fruit—March, 1900. Melbourne market.
,, ,, (withered)—September, 1900. Armadale.
Plum leaf—April, 1900. Armadale. (Figs. 26, 27, 136–157, 284–303.)
,, fruit—December, January. Armadale.
Apple leaf—December. Armadale.

14. *Macrosporium epicarpium*. N. sp.

Forming scattered black patches on fruit, where green portion of epicarp has already been destroyed, probably by gumming.

Hyphæ very variable and at least two forms may be distinguished—

(*a*) Olive-green form, which may shade off into fuliginous, or even colourless hyphæ, creeping, stout, septate, nodulose, much branched, branches slender, tapering, usually not constricted at septa. re-branching dichotomously, alternately or frequently in a H-form, from 15–1½ μ in diameter.

(*b*) Dark-brown form, tufted, septate, nodulose or cuboid, branched, very stout, up to 22μ diam.

Conidia terminal dark-brown, typically clavate, tapering into a longer or shorter stalk, generally 5-septate, with longitudinal septa sometimes in every division, 30–54 × 9–18 μ, average 47–54 × 15–18 μ.

Cladosporium stage.—Hyphæ in dense tufts, then breaking up into detached portions, dark-brown, septate, often moniliform, much branched, averaging 7–8 μ broad, conidia similarly coloured, usually 1-septate, and constricted at septum, thick-walled 19–21 × 9–10 μ.

On ripening fruit of nectarine. November, December, 1896. South Australia (Molineux).

Some badly diseased nectarines were received early in December, 1896, from Mr. Molineux, of the Agricultural Bureau, Adelaide, while the foliage accompanying them was remarkably clean, having only an occasional trace of "shot-hole." They were still in a green state, and about the size of a gooseberry. The surface seemed as if gnawed and excavated, in some cases nearly the whole of it, by some insect, leaving the surface brown, with occasional isolated green spots unaffected. A copious gumming accompanied the disease, so that the nectarines were quite sticky, and while the general appearance was brown, dark-cloured patches occurred. On examining portions of such patches under the microscope, abundant evidence of fungi was found. There were at least two different fungi present, one of which probably caused the disease (*Macrosporium)*, and the other accompanied it (*Cephalosporium*). (Figs. 28, 29, 30, 31, 32.)

15. *Epicoccum fructigenum.* N. sp.

Sporodochia gregarious, confluent, black, seated on a ruddy patch of colour.

Stroma convex, olivaceous consisting of septate hyphæ. Conidia crowded, pear-shaped, olivaceous and darker towards apex, reticulated, warted, 24–28 × 17–23 μ; conidiophores very short, colourless, immersed in stroma. On shrivelled-up cherries still attached to tree. May, 1900. Burnley, Victoria.

The cherries were black and represented the stone with a thin skin of shrivelled flesh. The fungus was in patches towards both ends, and the black confluent sporodochia were distributed over the dark-red base. This species differs from *E. granulatum* Penz. in the colour of the stroma and the conidia not being spheroidal and without pedicels. (Figs. 33, 34.)

16. *Rhizopus nigricans.* Ehr.

Sporangiferous hyphæ erect, usually in fascicles of 3–10, septate, springing from long, creeping, stolon-like hyphæ, that give off numerous rhizoids.

Sporangia globose, blackish-olive, granular; columella hemispherical or dome-shaped, at first colourless, finally yellowish-brown. Spores grey, sub-globose or somewhat elliptical, with granular contents, 13–15 μ, or about 13 × 10 μ. Zygospores brownish, ultimately black, globular, or sub-globose, provided with rounded warts, 160 μ diam. (March, 1901).

On shrivelled apricots, plums, and apples, Victoria. On the blotting-paper used for keeping the plums moist, a luxuriant crop of zygospores was found in all stages of growth. They were visible to the naked eye as little black points projecting from the substratum, with the delicate yellowish hyphæ at either side. Sporangiophores were found in connexion with them, either arising from the delicate hyphæ before swelling, or from the swollen portion or suspensor adjoining the zygospore. (Figs. 35, 36, 37, 38, 39.)

This fungus is stated by Dr. Halsted to cause a soft rot of sweet potatoes in America, but it is evidently saprophytic on the fruit.

17. *Phyllosticta prunicola.* Sacc.

Spots on leaf circular to sub-circular or irregular dingy-brown to ochraceous, margin similarly coloured, generally 2–3 mm. in diameter, but occasionally much larger and may be confluent, also forming raised brown patches on twigs and "scab" on fruit.

Perithecia on upper surface of leaf, occasionally on under, mostly at margin of spot, scattered, sometimes gregarious, minute, punctiform, showing black, yellowish-brown by transmitted light, globose, erumpent, sometimes superficial, membranaceous, with minute pore, 100-130 μ diameter.

Sporules dilute olive, elliptical, sometimes 1 or 2 guttulate, 5–8 × 3-3½ μ, rarely attaining a size of 9 × 4 μ.

On almond, apricot, cherry, peach, plum, fig, and apple trees, and leaves and fruit of grape vine. Victoria, South Australia, and Queensland :—

Almond leaf—April, 1900. Burnley.
December, 1900. Stawell.
December, 1900. Mordialloc.
,, fruit—1899. Burnley.
Apricot leaf—November, December, February, March, April, May. Armadale.
November, 1898. Nuriootpa. South Australia.
December, 1900. Queesland.
April, 1901. Near Melbourne.
,, shoot—June, 1900. August, 1901. Armadale.
,, fruit—December, 1899. Armadale.
,, ,, (withered)—June, 1900. Burnley.
Cherry leaf—March and April, 1901. Burnley.
December, 1900. Eltham.
,, fruit—December. Doncaster.
Peach leaf—January, February, March, April, 1901. Armadale.
September, 1892. Pakenham.
,, shoot—May, 1900. Armadale.
,, fruit (withered)—September, 1900. Armadale.
Plum leaf—November, February, May. Armadale.
Queensland.
,, shoot—June, 1900. Burnley.
,, fruit—January. Armadale.
Cherry-plum leaf—April, 1901. Near Melbourne.
Apple leaf. Armadale.
Fig fruit. Armadale.

The average size of a large number of sporules of undoubted *P. prunicola* was found to be 5–8 × 3–3½, but it is usually given as 5 × 3 μ. In the *Journal of Mycology* for 1886, *P. persicæ*, Sacc., is recorded on peach-leaves from Ohio, but as the ovate sporules, with a slight tinge of green, measure 4–6 × 2–3 μ, it is evidently *P. prunicola* which is meant.

Sporules sometimes issue in the form of fine dark tendrils, easily seen by the naked eye.

In the summer and autumn of 1883, Von Thuemen found "scabby" apricots in the Vienna market, caused by a fungus which he named *Phyllosticta vindobonensis*. He described it as follows :—Spots large, more or less orbicular, dirty greyish-brown, becoming corky. Perithecia numerous, punctiform, black, gregarious. Spores very numerous, shortly ellipsoid or sub-cylindrical, rounded at both ends, simple, eguttulate, homogeneous, cloudy hyaline or dilute smoky, 3½–5 × 1½–2½ μ. The description applies generally to the present fungus, only the spores are rather narrower; but I am inclined to think that, making due allowance for the different conditions prevailing where the apricots were grown, the fungi are probably the same (Figs. 40, 41, 70, 71, 72, 276–283, 317, 318).

18. *Fusarium prunorum.* N. sp.

Forming minute whitish patches on surface of blackened and shrivelled fruit.

Hyphæ hyaline, in tufts, septate, branched, bifurcating branchlets at apex bearing conidia, $3\frac{1}{2}$ μ broad.

Conidia hyaline, slightly curved, acute at both ends, usually 5-septate, not constricted at septum, with finely granular contents, 50–60 × $4\frac{1}{2}$–5 μ.

On shrivelled and blackened apricot fruit. June, 1900. Burnley, near Melbourne.

It differs from *F. putaminum*, Sacc., in the 5-septate conidia being twice the length, and in the minute sporodochia not being compact (Fig. 42).

19. *Fusarium putaminum.* Thuem.

Sporodochia superficial, widely effused, loose in texture, mould-like, at first snow-white, ultimately pale salmon-pink, covering about half of apricot kept moist. Hyphæ densely fasciculate, pale pink in mass, septate, frequently branched, branches often standing out at right-angles or dichotomous, finely granular contents, 4 μ broad.

Conidia produced at the tips of the branches, fusiform, acute at both ends, slightly curved, contents finely granular, generally 3-septate, 22–28 × 3–4 μ.

On ripe apricots kept damp. January, 1899. Armadale, near Melbourne.

The apricots were plucked when ripe on 1st January, and were "scabby." They were kept moist, and in about a week the fruit shrivelled and a profuse development of white mould took place, which gradually became pale salmon-pink. Then a pale fawn skin formed on portions containing the perithecia of *Coniothyrium pruni*, *n. sp.*

This species was first found in Austria, on stones of plums which had lain on the damp earth a considerable time and were putrid. In Thuemen's species the sporodochium is said to be compact, but otherwise his drawing and description agree with this one (Figs. 43, 44).

20. *Ovularia cerasi.* N. sp.

Forming scabby patches on one side of ripe cherries, and causing cracking of the skin.

Hyphæ delicate, hyaline, septate, branched in tissues, with projecting conidiophores, having granular or vacuolated contents, $3\frac{1}{2}$–4 μ broad.

Conidia colourless, oblong, $6\frac{1}{2}$–$7\frac{1}{2}$ × $3\frac{1}{2}$ μ.

On Cherry fruit. December, 1898. Victoria (French).

In *O. circumscissa*, Sorok., causing "shot-hole" of the leaf of *Prunus*, the conidia are greenish and much larger, 15–18 × 6–7 μ. (Figs. 45, 46.)

LEAF DISEASES.

I am afraid the average grower hardly realizes how much he loses through the imperfect action of the leaves. The leaves serve to take in the necessary oxygen and carbonic acid, as well as to exhale various gases, and they are also the great transpiring organs of the plant. Hence, if the moisture taken up by the roots is not allowed to pass off freely when it has left behind the nutritive matters dissolved in it, then it is like the clogging of the nozzle of a spray-pump ; the roots do not act properly and the whole tree suffers. What an amount of carbonaceous matter enters into the composition of a tree, and yet it must all be taken in through the agency of the leaves in the form of a gas. If the leaves fail to perform their functions properly, through disease however caused, or if they drop prematurely, then the wood formed is poor in quality and not sufficiently hardened to resist the frost, while the fruit is imperfectly nourished and does not attain its full development or flavour. The gumming of various stone-fruit trees is becoming very marked, and is causing a considerable amount of loss ; and while the cause of the gumming is attributed to a variety of causes, I am inclined to think that the deficient leaf action caused by disease, and the consequent injurious effect upon the wood formed, has a great deal to do with it. At any rate, in such trees it is noticeable that the leaves are affected with "shot hole," or "rust," or "curl," and the usual concomitant of these diseases is copious gumming.

II. Fungi on Leaves (49).

21. Puccinia pruni.
22. Gnomonia circumscissa.
23. Pleospora aurea.
24. Pleospora herbarum.
25. Pleospora permunda.
26. Exoascus deformans.
27. Rhizopus apiculatus.
28. Physarum calidris.
29. Phyllosticta persicæ.
    [Phyllosticta prunicola.]
30. Pyrenochæta rosella.
31. Ascochyta chlorospora.
32. Ascochyta crystallina.
33. Darluca filum.
34. Didymochæta australiana.
35. Septoria effusa.
36. Septocylindrium bonordenii.
37. Cladosporium herbarum.
38. Cladosporium phyllophilum.
39. Cladosporium prunicolum.
40. Cladosporium condylonema.
41. Macrosporium parasiticum.
42. Alternaria pruni.
43. Alternaria tenuis.
44. Rosellinia aurea.
45. Pleospora vulgaris

46. Leptosphærulina australis.
47. Phyllosticta matthiolana.
48. Vermicularia angustispora.
49. Sphæropsis cerasifolia.
50. Ascochyta ovalispora.
51. Kellermannia pruni.
52. Monilia olivacea.
53. Trichoderma racemosum.
54. Aspergillus candidus.
55. Langloisula rubigo-spora.
56. Hormiscium undulatum.
57. Dematium pullulans (Aureobasidium form).
[Clasterosporium carpophilum.]
58. Cercospora circumscissa.
59. Fusarium sarcochroum.
60. Epicoccum granulatum.
61. Capnodium armeniacæ.
62. Phyllosticta macrospora.
63. Phyllosticta chlorospora.
64. Camarosporium prunifolium.
65. Macrosporium prunicolum.
66. Tubercularia olivacea.
67. Penicillium roseum.
68. Bacteriosis.
69. Volutella penicillioides.

21. *Puccinia pruni.* Pers.

Uredospores. — Sori hypophyllous, or occasionally epiphyllous, minute, light brown to rusty brown, orbicular, scattered, but grouped in patches, often confluent; soon naked, pulverulent, seated on yellow spots corresponding to those on upper surface.

Uredospores variable in form, from elongated ovate to almond-shaped, usually shortly stalked, but sometimes stalk 22 μ long, closely echinulate, yellowish; apex yellowish-brown, thickened, with spines less prominent, bluntly conical or rounded, with at least two opposite germ-pores situated just behind thickened apex, 26–44 × 12–20 μ; intermixed with numerous, capitate, pale-yellow, long-stalked paraphyses, sometimes attaining a length of 60 μ.

Teleutospores.—Sori scattered or confluent, isolated or in groups, punctulate, pulverulent, seal-brown, known from the uredospore-sori by their dark, almost black appearance.

Teleutospores oblong, composed of two globose cells, apparently flattened at their junction, lower usually smaller and paler than upper, but sometimes similar in size and colour, sharply constricted in the middle, and cells readily separating; epispore uniformly thick, dark-brown, thickly studded with short stout spikes, 25–37 × 17–21 μ; pedicels short, hyaline, deciduous or persistent; paraphyses numerous.

On leaves of almond, apricot, nectarine, peach and plum; fruits of almond, apricot, and peach; stem of peach. November–June. Victoria, New South Wales, Queensland, South Australia, and Tasmania.

Occasionally the teleutospores are 3-celled, the apical cell being darkest in colour and almost globular, the median rather compressed, and the basal cell elongated and tapering towards base, attaining a size of 58 × 22 μ.

When the rust is on the fruit, uredospores may be produced both at the surface and in the pulp beneath, which is quite firm at that spot compared with the surrounding tissue. (Figs. 47, 48, 49, 306, 307, 308, 309.)

22. *Gnomonia circumscissa.* N. sp.

Minute, black, gregarious, punctiform perithecia, mostly on upper but also on under surface of leaf.

Perithecia black, but dark golden brown by transmitted light, erumpent, membranaceous but tough, flask-shaped, with round pore at apex of projecting beak, 120–150 μ diam., average 130 μ, and beak 60–75 μ long.

Asci subsessile, 8-spored, of two kinds—*(a)*, commonly short and stout, obclavate, with sporidia only partially filling ascus, and usually 3-rowed, 50–60 × 24–25 μ; *(b)*, more rarely elongated cylindrical, bulging towards base and sporidia filling entire ascus, generally 2-rowed, 95–130 × 15–17 μ.

Sporidia sub-hyaline, or pale yellow in mass, elongated ovate-oblong, 1-septate, not constricted at septum, eguttulate, with granular contents, 20–26 × $5\frac{1}{2}$–$7\frac{1}{2}$ μ, average 20–22 × 6 μ.

On leaves of apricot, almond, cherry, plum, peach; also on apple and vine.

On the stone-fruit leaves it occurred on definite grey or ochraceous rounded spots, from which the tissue ultimately dropped out, also scattered promiscuously over the leaf when dead.

Almond-leaf—July, 1900. Ardmona.
Apricot-leaf—July, 1900. Ardmona.
Cherry-leaf—April, 1900. Burnley.
Peach-leaf—July, 1900. Ardmona.
Plum-leaf—April and July, 1900; April and May, 1901. Ardmona.
Kelsey plum-leaf—April, 1900. Burnley.

At Ardmona it was associated with *Ascochyta chlorospora* and *Macrosporium prunicolum*.

It would naturally be expected that the species of *Gnomonia* found on cultivated stone-fruit trees in Australia would be the same as that occurring in Europe, but it differs from *G. erythrostoma*, Auersw., in the following particulars:—It occurs on definite rounded spots, which ultimately become "shot-holes," while the other produces a yellowing or browning of the leaf, giving it a scorched appearance. The asci are rarely cylindrical, but mostly obclavate, and the sporidia, instead of being spuriously 1-septate and 4-guttulate, are distinctly 1-septate and eguttulate, and rather longer. *Ascochyta chlorospora* is often associated with this species, and is probably the pycnidial stage, just as *Septoria erythrostoma*, Thuem., is considered to be that of *Gnomonia erythrostoma*. (Figs. 50, 51, 52.)

23. *Pleospora aurea.* Ellis.

Perithecia black, erumpent, loosely gregarious, membranaceous, globose or depressed globose, with circular pore, 120–150 μ diameter, or sometimes 180 μ.

Asci elongated clavate, straight or slightly curved, shortly stipitate, 8-spored, 85–95 × 19–22 μ.

Paraphyses hyaline, filiform, bifurcating at apex, rather longer than asci, about 1 μ broad.

Sporidia inordinate or bi-seriate, ovate-elliptical, bright golden yellow, becoming a little darker, transversely 4-septate, not constricted at septa, and with longitudinal septum in each of the three median divisions, dividing it into cuboid portions, 22–24 × 11 μ.

On decaying apricot leaves. July, 1900. Ardmona, Victoria.

This species differs from the type described and figured in Ellis and Everhart's "North American Pyrenomycetes" in the absence of the fringe of brown, septate, branching, mycelial threads to the perithecia, in the sporidia being more ovate in outline and narrower, and in the paraphyses being more slender. The sporidia are very distinct—regularly 4-septate, not constricted at septa, with longitudinal septum running through three median divisions and forming cuboid portions. Intermixed with this was *P. permunda*, Cooke, and curiously enough in the original description of these two species the measurements were interchanged and confused. The 4-septate sporidia of *P. aurea* are quite distinct from the 3-septate sporidia of *P. permunda*, although Berlese, in his monograph of the genus Pleospora, places the former as a synonym of the latter. (Figs. 53, 54, 55.)

24. *Pleospora herbarum.* Rab.

On yellowing leaves of plum. April, 1900. Armadale, near Melbourne.

The tip of the leaf, on which the perithecia occurred, was greyish-brown and withered. There were only a few "shot-holes" on other portions of the leaf.

On decaying leaves of apricot. July, 1900. Armadale, near Melbourne. (Figs. 56, 57, 58.)

25. *Pleospora permunda.* Cooke.

Perithecia black, erumpent, scattered, membranaceous, firm, globose, about 200 μ diameter.

Asci straight or slightly curved, elongated clavate, very shortly and stoutly stalked, subsessile, about 80 × 20 μ.

Paraphyses hyaline, filform, equal to or slightly longer than asci. Sporidia bi-seriate, yellow at first, becoming dark-brown, transversely 3-septate, constricted at median septum, and very slightly at the other septa with longitudinal septum extending across two middle cells, ellipsoidal and tapering more to one end than the other, unsymmetrical, 22–24 × 9–11 μ.

On decaying apricot leaves. July, 1900. Ardmona, Victoria.

Associated with *P. aurea*, Ellis, from which it differs in the shape, colour, and septation of sporidia.

These two species are found on dead herbaceous stems in the United States and in Algeria. (Figs. 59, 60.)

26. *Exoascus deformans.* Fckl.

Developing on both surfaces of leaves, but mostly on the upper, and forming scattered swollen places, which become powdered with white meal.

Asci cylindrical, apex rounded, 35–40 × 9–12 μ; basal cell, 12–16 μ long, up to 5 μ thick at top, and narrowing downwards and penetrating between epidermal cells. Sporidia continuous, hyaline, elliptical, smooth, 7–8½ × 3–5 μ.

On leaves and twigs of peach, and on nectarine leaves and fruit, October-December. Common distortion of the young shoots likewise occurs, and I have had specimens of nectarines, both from New South

Wales and Victoria, in which the fruit was badly blistered, but no spores were obtained. In such cases the leaves of the nectarine were badly affected with "curl."

In the northern districts this fungus occurs during September and October, and only in bad seasons extending to November, while in the coastal districts November is the month in which it is most common.

[Very probably the conidia mentioned by Massee, quoting Rodway, in Kew Bulletin, 1900, p. 181, regarding this fungus in Tasmania belong to *Cladosporium phyllophilum* which generally follows the *Exoascus* in Victoria.] (Figs. 61, 310, 311.)

27. *Rhizopus apiculatus.* N. sp.

Sporangiferous hyphae erect, usually in fascicles of three, simple, sienna-brown, thick-walled, about 2 mm. high and averaging 26μ broad, springing from relatively short creeping stolons similarly coloured, with root-like almost colourless portions. Sporangia globose, white to naked eye, but sooty-brown by transmitted light, smooth, 150–160μ diameter. Columella elongated, slightly swollen, acute at apex. Spores pale fuliginous, sub-globose to oval, smooth, imbedded in highly granular gelatinous material, 7–8μ diameter, or 8–11 × $6\frac{1}{2}$–$7\frac{1}{2}\mu$.

On dead leaves of plum and apricot. April, 1900. Ardmona, Victoria (Robinson).

It differs from *R. nigricans*, Ehr., in the elongated slightly-swollen columella, terminating in an apical point, and not being hemispherical, and in the spores being 7–8μ in diameter when sub-globose, or up to 11 × 7μ when elliptical.

The specific name is given on account of the characteristic pointed nature of the apex of the columella (Figs. 62, 63, 64).

28. *Physarum calidris.* Lister.

Plasmodium? Total height 1 to $1\frac{1}{2}$ mm.

Sporangia sub-globose, stipitate, erect or somewhat inclined, somewhat gregarious, 0·5–0·7 mm. diameter, white, rugose; sporangium-wall membranous, colourless above, with dense clusters of innate white granules; thickened and persistent at the base, partaking of the colour of the stalk.

Stalk subulate or equal, furrowed, one to three times the height of the sporangium, dark-brown.

Columella, none.

Capillitium of colourless branching threads, with numerous or few white lime-knots.

Spores pale brownish-violet, almost smooth, 8 to 11μ diameter, or 12–13μ.

On dead plum leaves. April, 1900. Ardmona, Victoria.

This species was determined by Lister, and he remarks that "It is interesting as the first example we have any record of from Australia." (Figs. 65, 66, 67.)

29. *Phyllosticta persicæ.* Sacc.

On the ordinary brown "shot-hole" spots, but not with concentric markings.

Perithecia generally on lower surface, covered by epidermis, depressed-globose, black but clear-brown by transmitted light, with round papillate mouth.

Sporules hyaline, elongated elliptic, 6–7 × 3–3½ μ.

On apricot leaves kept moist. March, 1901. South Australia.

On peach and plum leaves. March and April and November, 1901. Armadale.

This species has only hitherto been recorded for the peach in Italy. On the apricot the spots are not at all concentrically zoned, but the sporules generally agree in size and shape (Figs. 68, 69, 316).

30. *Pyrenochaeta rosella.* N. sp.

Generally distributed over the leaf, and sometimes associated with a whitening of the surface.

Perithecia scattered, black, dark-brown by transmitted light, at first covered, then erumpent, depressed-globose, membranaceous, of parenchymatous texture, with yellowish-brown divergent spines around mouth, sometimes slightly rostrate, about 180 μ diameter, spines rigid, straight, tapering towards apex, distinctly septate, 200–220 μ long, and about 8 μ broad towards base. Sporules hyaline individually, pale rose-tint in mass, cylindrical, rounded at both ends, sometimes slightly tapering towards basal end, with finely granular contents, 15–20 × 3½–4 μ.

On rotting leaves of almond, apricot, and peach, and decaying fruit of apricot.

Almond-leaf. July, 1900. Ardmona.
January, 1901. Stawell.
Apricot-leaf. April–July, 1900. Ardmona.
Fruit. December, 1900. Armadale.
Peach-leaf. Burnley.

The specific name is given from the pale-pink tint of the sporules.

The Armadale apricot leaves were plucked on 1st October, and were affected with *C. carpophilum*. Two months afterwards the leaves were kept moist under a bell-jar, and in about a fortnight the *P. rosella* was very common. In the culture the perithecia were quite superficial (Figs. 73, 74, 313).

31. *Ascochyta chlorospora.* Speg.

Perithecia on upper and under surface of leaves, black, punctiform, dark olivaceous by transmitted light; scattered, beneath epidermis, or slightly erumpent; membranaceous, sometimes papillate, with mouth up to 47 μ diameter. Average size 100–130 μ diameter, but may reach 150 μ.

Sporules transparent olive, elongated elliptical to oblong, rounded at both ends, or slightly pointed at one end, 1-septate (occasionally 2–3 septate) slightly constricted at septum, with granular contents 10–16 × 3–4½ μ, average 11 × 3½ μ.

On almond, apricot, peach, plum, and vine leaves; also on apricot stones and shrivelled peaches. All the year round, but principally autumn and winter.

Almond-leaf. December, 1900. Stawell.
Apricot-leaf. July, 1900. Ardmona.
April, 1901. Near Melbourne.
Fruit. September, 1900. Burnley.
Peach-leaf. July, 1900, and February, 1901. Ardmona.
Fruit. September, 1900. Armadale.

Plum-leaf. April, 1900. Armadale. South Australia.
Cherry-plum-leaf. July, 1900, and January, 1901. Ardmona.
Vine leaves. April and May, Armadale.

Sometimes associated with *Clasterosporium carpophilum* and *Phyllosticta prunicola*, and often with *Gnomonia circumscissa*.

On almond leaves kept moist for twelve days, perithecia were sparingly developed, which were flask-shaped and beaked, resembling the genus *Rhynchophoma*. They were also considerably larger than the normal, but this is a general feature of perithecia developed under such conditions (Figs. 75, 76).

32. *Ascochyta crystallina*. N. sp.

Perithecia prominent, large, brown, greenish-brown by transmitted light; depressed-globose, membranaceous, with round apical pore.

Sporules hyaline in mass, cylindrical, rounded at both ends, 1-septate, not constricted at septum, 13–15 × 2–3 μ.

On Almond-leaf. December, 1900. Stawell.

The leaves were kept moist under a bell-jar for about a fortnight.

The specific name is given from the spores appearing in clusters, like so many raphides (Figs. 77, 78).

33. *Darluca filum*. Cast.

Perithecia gregarious, very minute, conical to globose, pierced, black, shining, 200–220 μ diameter.

Sporules oblong-fusoid, straight, 1-septate, not constricted at septum, hyaline to pale-greenish, 2-guttulate, 13–15 × 3–4 μ.

Parasitic on *Puccinia pruni* on peach leaves, branches, and fruit, and on plum-leaves.

Peach-leaf. May, 1895. Armadale.
Branch. October, 1898. Healesville.
December, 1900. Auckland, New Zealand.
April, 1901. Ardmona.
Fruit. February, 1900. Panton Hill.
Plum-leaf. Burnley.
Kelsey plum-leaf. April, 1900. Burnley.

The peaches were badly spotted and going to decay.

Pustules of *Puccinia pruni* were found in connexion with the spots, and on making sections *D. filum* was found deeply imbedded in the tissue.

The two fungi were always found associated in this particular case, but in another instance where the peaches were obtained at the Western Market, Melbourne, the rust-pustules occurred both on the surface and in the pulp beneath, without any trace of the parasitic *Darluca*. It also occurred alone on discoloured spots of peach twigs. Associated with it was a species of *Fusarium*, in which the conidia were colourless, fusiform, curved, acute at both ends, up to 3-septate, 26 × 2½ μ (Figs. 79, 80, 81).

34. *Didymochaeta australiana*. N. sp.

Perithecia somewhat gregarious, black, erumpent, globose, membranaceous, with papillate mouth 100–160 μ diameter; bristles surrounding mouth, olivaceous, tapering to a point, 1-septate towards base, 75–95 μ long.

Sporules hyaline, cylindrical-oblong, rounded at both ends, with finely granular contents, 1-septate, usually slightly constricted at septum and often not quite median, with one division stouter than the other, 18–22½ × 5–6½ μ.

On dead almond-leaves—July, 1900. Ardmona, Victoria.

This genus was constituted by Saccardo in 1898 for a species, *D. americana*, Ell. and Sacc., found on dead stems of *Frasera speciosa* in Colorado, United States. It is just a Pyrenochaeta in which the sporules are 1-septate.

On the same almond-leaf *Pyrenochaeta rosella*, McAlp., was found, the sporules of which, in addition to being continuous, are rather shorter and much narrower than those of *D. australiana*.

This is a comparatively rare fungus, and might be regarded by some as the mature stage of *Pyrenochaeta rosella*, but the latter is a most common saprophyte, and the perithecia are furnished with strong prominent bristles, visible to the naked eye. In *Didymochaeta*, however, the bristles are comparatively few and short, and quite distinct from the former (Figs. 82, 83).

35. *Septoria effusa* (Lib.). Desm.

Perithecia minute, black, immersed, prominent, very fragile, yellowish-brown by transmitted light; with minute pore, somewhat pear-shaped, about 100 × 85 μ, sub-gregarious on definite, orbicular, ruddy spots with raised margin.

Sporules hyaline, slender, rounded at both ends or slightly narrowed, stright or slightly curved continuous to 5-septate, generally 1-septate, 18–27 × 1½ μ, average 20 μ long.

On upper surface of almond leaves. January, 1900. Phillip Island, Victoria.

The spots ultimately fall out and cause "shot-hole," and the fungus may also occur on the withering tips of the leaves.

It differs from *S. cerasi*, Pass., in the sporules, being usually septate, and from *S. disseminata*, Desm., in occurring on definite "shot-hole" spots, and in the sporules being one to several septate and rounded at the ends. (Figs. 84, 85.)

36. *Septocylindrium bonordenii*. Sacc.

Forming numerous whitish patches on dead leaves.

Hyphæ scanty, colourless, 3½ μ broad.

Conidia hyaline, cylindrical, straight, rounded at both ends, 3-septate, not constricted at septum, in chains, 20–26 × 3½ μ.

On dead apricot leaves. July, 1900. Armadale, near Melbourne. The conidia resemble those of the type, but are somewhat shorter (Fig. 86).

37. *Cladosporium herbarum*. Link.

On leaves of plum. April 1900. Armadale, near Melbourne.

The brownish decaying margins of leaves affected with "shot-hole" had the tufts of this fungus, and probably hastened the decay of the leaves.

On fruit of cherry, along with *Phyllosticta vulgaris*, var. *cerasi*.

This is the most widely distributed of all the species of fungi, and occurs on all kinds of plants, especially when decay is about to begin. It is found on withered leaves still attached to the tree, as well as on those which have fallen, and is met with on the various stone-fruit trees. The dark olivaceous tufts of the fungus indicate that decay has set in and the process is hastened, although not originated, by this world-wide species.

38. *Cladosporium phyllophilum.* McAlp.

Forming a continuous, dark, olivaceous, minutely velvety layer over the diseased wrinkled surface of the leaf caused by *Exoascus deformans*, Fckl.

Hyphæ smoky-brown to pallid, septate, very sparingly branched, about 4 μ broad, occasionally nodulose.

Conidia very variable in size and shape, terminal or lateral, in chains, pale-green or pallid, pellucid, continuous or 1–3 septate, very commonly uniseptate, subrotund to oval or elongated, rod-shaped, from 5½ μ diam., or averging 19–20 × 4–5½ μ.

On both surfaces of deformed portion of leaf, and occasionally on branches of peach ; also on apricot "shot-hole" leaf. Spring, summer, and autumn. Common in Victoria.

At first sight this species might be mistaken for the common *C. herbarum*, but the erect or ascending hyphæ are narrower, and the conidia are in chains and not constricted at the septa. [In Kew Bulletin, 1900, p. 181, Massee quotes Rodway regarding conidia following *Exoascus deformans* on peach leaves. Probably this is the species referred to.]

This fungus has been found both in the coastal and northern districts. In the northern districts a closely allied fungus was found on the same matrix, viz., *Cladosporium condylonema* (Figs. 87, 88).

39. *Cladosporium prunicolum.* N. sp.

Tufts minute, dark-brown, on partly decayed leaf. Creeping hyphae olivaceous-brown, irregular, flexuous, septate, constricted at septa, averaging 9–10 μ broad, but sometimes broader.

Conidiophores upright, radiating, similarly coloured, simple, generally 2–3 septate, broad at base and tapering towards apex, average 50 × 6 μ.

Conidia elongated-elliptic, at first pallid, continuous and contents granular, then similarly coloured to conidiophores, finally 3-septate and slightly constricted at median septum, echinulate, in chains at least of two 16–21 × 8–9 μ.

On apricot leaves. December, 1899. Armadale, near Melbourne.

It differs from *C. epiphyllum*, Mart, in the simple and distinct conidiophores, and in the conidia being nearly twice as broad.

It is associated with "shot-hole," *Clasterosporium carpophilum* and *Phyllosticta prunicola* being also found on the same leaf (Figs. 89, 90).

40. *Cladosporium condylonema.* Pass.

Tufts minute, round, compact, olivaceous ; creeping hyphæ olive-brown, irregular, flexuous, septate, constricted at septa, averaging 9–10 μ broad, but sometimes broader.

Conidiophores fasciculate, radiating, olivaceous, flexuous, 2-3 septate or multi-septate, generally broad at base and tapering towards apex, swollen at the joints, 50–100 × 5–6½ μ, or even much longer. Conidia olive-brown, 1-2 septate, rarely 3-4 septate, very slightly or not at all constricted at septa, elongated elliptical, echinulate, in chains at least of two, terminal or occasionally lateral at the joints, 20–34 × 9–11 μ, occasionally reaching 39 × 13 μ.

Almond-leaf. December, 1900. Nagambie.
Apricot-faded flower. October, 1900. Ardmona.
leaf with "shot-hole." Armadale.
Peach-leaf. April and November, 1900. Ardmona.
Plum-leaf. February, 1900. Panton Hill.
April and May, 1901. Ardmona.

In the Armadale specimens it was associated with "shot-hole," *Clasterosporium carpophilum* and *Phyllosticta prunicola* being also found on the same leaf.

In the Ardmona specimens it occurred on the calyx of faded flowers of apricot, on withering leaves of peach affected with "curl," and on "shot-hole" spots of early-falling plum leaves.

When the leaves were placed in a moist chamber long flexuous hyphæ were produced, and sometimes two conidia occurred at the apex of a conidiophore. This species was first discovered in Italy, in 1889, as a parasite on plum leaves, attacking them when in full vigour. The conidia are described as 1-septate, but occasionally they may be more (Figs. 91, 92, 93).

41. *Macrosporium parasiticum.* Thuem.

Mycelium ramifying in tissue of leaf, and consisting of almost colourless to greenish, septate, branched hyphæ, giving rise to tufts of fertile hyphæ. Fertile hyphæ fasciculate, ascending then divergent, simple or occasionally branched, septate, not constricted at septum with swollen apex, olivaceous to pale olive-brown, 50–100 μ long, average 75 × 4–5 μ.

Conidia variable in size, dark olive-brown, elongated-oblong to oblong obovate, rounded at both ends, with three principal transverse septa, and further sub-divided by oblique, transverse, or longitudinal partitions, up to 7-septate, slightly constricted at principal septa, sometimes deeply in the middle, wall rough from minute projections 35–50 × 16–20 μ.

Almond leaves. November, 1900. Myrniong, Victoria.

It also occurred on apple leaves associated with *Phyllosticta briardi*, and on other decaying leaves.

This is the first record of this species for Australia, and it is rather interesting as having been proved to be the conidial stage of *Pleospora herbarum*, Rabenh., by Miyabe,* who regards it as identical with *M. sarcinula*, Berk. It occurred on the same leaf with *Clasterosporium carpophilum*, but there was no connexion between the two. The knob at the apex of the fertile hypha had its lateral walls thickened in the form of a band, while the wall at the end remained thinner in texture and lighter in colour. Hence this terminal wall sometimes collapsed, after the conidia were shed, and gave to the apex a characteristic cup-shaped form. The tufts protrude through stomata or the ruptured epidermis, and in some of them I counted as many as 25 fertile hyphæ. The knobbed apex and the olive-brown sarcinula-like, finely echinulate conidia are very characteristic for this species.

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* On the Life-History of *M. parasiticum*, Thuem., Ann. Bot., Vol. III., No. IX. (1889.)

The almond leaf on which it grew was kept in a moist chamber for four days (Figs. 94, 95, 96).

42. *Alternaria pruni.* N. sp.

Forming numerous minute tufts on apricot leaf affected with "shot-hole" after being placed under bell-jar.

Hyphæ radiating, olivaceous, simple, occasionally very shortly branched, septate, several septa, not generally constricted at septa, equal in breadth throughout, rounded at apex, variable in length, but reaching 120 μ, and averaging 4½–5 μ broad.

Conidia in chains, clear olivaceous, clavate or elongated clavate, stalked or stalkless, 5–8 septate, generally constricted at septa, with longitudinal or oblique septa in most of the divisions, and often divided into cuboid portions, 52–64 x 13–18 μ.

On apricot leaves intermixed with *Phyllosticta prunicola.* November, 1900. Armadale, Victoria.

This species differs from *A. brassicæ* in the longer septate conidiophores (Figs. 97, 98.)

43. *Alternaria tenuis.* Nees.

Hyphæ short, septate, simple or occasionally shortly branched, olivaceous, or olive-brown, about 5 μ broad.

Conidia in chains, deciduous, flask-shaped, olivaceous then olive-brown, 3–5 septate, muriform, variable in size and shape, 28–36 x 13–15 μ.

On plum leaf. January, 1901. Ardmona, Victoria.

The leaf was kept in moist chamber, and this species developed on the perithecia of *Rosellinia aurea* (Figs. 99, 100).

44. *Rosellinia aurea.* N. sp.

Perithecia golden brown, superficial, gregarious or scattered, usually two or three together, globose, membranaceous, with tuft of hyaline, rigid bristles at apex, surrounding central pore, 300–400 μ diameter. Asci in tufts, obovate, tapering into short stalk, 8-spored, 45 x 28 μ; paraphyses hyaline, filamentous, longer than ascus. Sporidia distichous, colourless to olivaceous at first, and finally smoky-brown, navicular, with short obtuse hyaline apiculus at each end, 24–26 x 13–14 μ.

On plum and apple leaves in moist chamber. Victoria.

It also grew artificially on damp blotting-paper. The superficial perithecia have a golden yellow appearance, and the sporidia ooze out in coherent threads, apparently becoming entangled in the hairs (Figs. 101, 102, 314).

45. *Pleospora vulgaris.* Niessl.

Perithecia scattered, covered by the epidermis, depressed globose, fragile, dark brown, with papillate mouth, about 250 μ diam.

Asci cylindric clavate, attenuated into slender stalk (about 17 μ) 95–105 x 18–19 μ.

Sporidia 8, distichous, single at base and apex, ellipsoid, rounded at both ends, but usually more pointed at upper end, slightly inequilateral, transversely 5-septate, 3 septa being prominent and constricted at median one, usually with longitudinal septum in each division, except the end segment, at first yellowish-green, then honey colour, finally dark yellowish brown, $22–24 \times 8\frac{1}{2}–9\frac{1}{2}\ \mu$, average $22 \times 8\frac{1}{2}\ \mu$. Paraphyses a little longer than asci, numerous, hyaline, septate, simple or very sparingly branched.

On cherry leaves. March 1901. Box Hill.

It differs from *P. media*, Niessl, in the perithecia being scattered and not gregarious and in the sporidia not having longitudinal septa in the terminal segments. Aderhold found *P. vulgaris* on cherry leaves in Germany while looking for the ascidial form of *Clasterosporium carpophilum.* It occurred only on spots produced by this fungus, and was therefore probably genetically connected with it (Figs. 103, 104).

LEPTOSPHAERULINA. McAlp.

Characters as in *Pleosphaerulina*, but sporidia ultimately brown.

46. *Leptosphaerulina australis.* N. sp.

Perithecia gregarious, covered or slightly erumpent, globose, with slightly papillate mouth, membranaceous, of parenchymatous texture, pale brown by transmitted light, average 150 μ diam.

Asci shortly clavate or saccate, distichous or tristichous, 8-spored, $75–80 \times 28–50\ \mu$, average $75 \times 37\ \mu$.

Sporidia at first hyaline, ultimately brown, elongated oblong, rounded at both ends, 5-septate, not constricted at septa, with longitudinal septa generally in the two median divisions, $30–32 \times 11\ \mu$.

On apricot leaf. December, 1900. Queensland.

The leaf was one of a number affected with shot-hole received from Queensland, but which showed no mature fungus. After about 14 days in a moist chamber, the above species was found along with others, though not regarded as a parasite (Figs. 105, 106, 107).

This species has been found very plentiful on withered parts of leaves of apricot, vine, Dolichos, Poa, and Lolium.

47. *Phyllosticta matthiolana* (Sacc. and Matt.). McAlp.

Synonym—*P. perforans.* Sacc. and Matt.

Spots circular or elliptical, occasionally irregular, increasing in size, then clearly cut and tissue falling away.

Perithecia more or less gregarious, mostly epiphyllous, punctiform, black, covered by the whitish cuticle which is slightly raised, or erumpent, 90–112 μ diam. Sporules very small, shortly cylindrical, hyaline $3–3\frac{1}{2} \times \frac{1}{2}–\frac{3}{4}\ \mu$. On living leaves of apricot, cherry, peach, plum, and apple.

Almond leaf. April, 1900. Victoria.
Apricot leaf. May, 1901. Armadale.
Cherry leaf. March, 1891. Myrniong.
Cherry leaf. December, 1901. Port Fairy.
Cherry leaf. March, 1901. Burnley.
Peach leaf. April and May, 1901. Armadale.
Plum leaf. April, 1899 and 1900. Armadale.

This species was originally described by Saccardo on the leaves of the cherry laurel (*Prunus Lauro-cerasus*), and seems to agree with the present one, although in many cases the presence of short filiform basidia is very marked, while in others again there is hardly any indication (Figs. 108, 109).

48. *Vermicularia angustispora.* N. sp.

Perithecia few, superficial, black, sub-spherical, flattened at base, membranaceo-carbonaceous 120 × 95 μ or 150 μ diam., clothed with long, rigid, septate, pointed, opaque, divergent fuliginous hairs (up to 17), 140 μ long, arising from near base.

Sporules greyish in mass, numerous, hyaline individually, elongated, slender, straight or mostly curved, truncated at one end and rounded at other, 13–16 × 2 μ.

On decaying plum leaves under bell-jar. January, 1901. Ardmona. It differs from *V. macrochaeta*, Desm., in not being aggregated on black spots and in the perithecia being superficial. The sporules of the latter were not observed, hence no comparison can be made (Figs. 110, 111).

49. *Sphaeropsis cerasifolia.* N. sp.

Perithecia scattered or sub-gregarious, on both surfaces of leaf, globose, erumpent, black, membranaceous, with round apical pore, 150–200 μ diam.

Sporules oblong ellipsoid or elongated pear-shaped, either truncate at base or more commonly rounded at both ends, but broader at apex; clear yellowish-brown, thick-walled, finely granular contents at first, 25–30 × 10–12 μ; sporophores hyaline, slender, attached to tapering end, up to 17 × 1¾ μ.

On dead leaves of cherry. March, 1901. Box Hill.

This species occurred on the margins of the brown withered leaves still hanging on the tree.

S. peckii, Sacc., and *S. cerasina*, Peck., occur on dead branches of *Prunus*, but the spores are rather shorter than the above (Figs. 112, 113).

50. *Ascochyta ovalispora.* N. sp.

Perithecia minute, black, innate, membranaceous, with apical pore.

Sporules pale-green, elliptical to ovate, 1-septate, not constricted at septum, occasionally 2-septate, 7–9 × 3–4 μ.

Cherry leaf. April, 1900. Burnley.

Cherry twigs. March, 1901.

Plum leaf. April, 1900. Armadale.

The sporules are quite distinct from those of *A. chlorospora*, the latter being more oblong, while the former are more ovate (Fig. 114).

51. *Kellermannia pruni.* N. sp.

Perithecia scattered, black, dark-brown by transmitted light, depressed globose, membranaceous, with papillate mouth, 200–250 μ diam.

Sporules chloro-hyaline or yellowish-hyaline, cylindrical or slightly fusoid, generally slightly curved, 3–4 septate, not constricted at septa, blunt at either end, apical segment perfectly hyaline, and bearing two to three diverging setæ about 15–17 μ long, and borne by slender hyaline basidia, about 9 μ long, which are usually detached with the sporules, 28–34 × 4½–5 μ.

Almond leaves kept moist. December, 1900. Stawell.

Apricot twig living. July, 1900. Armadale.

Plum leaves kept moist. March and April, 1901. Armadale.

Peach and plum leaves. May, 1901. Armadale.

This genus was constituted by Ellis and Everhart in 1885, as having septate and stipitate spores; then in 1886 it was amended, as the so-called stipe was found to be an awn-like appendage proceeding from the apex of the spore, while the spores themselves were sessile. In the present species there are three diverging setæ at the apex, and at the base a slender stipe usually attached at an angle to the spore. The genus is practically *Pestalozzina*, with a perithecium. The terminal cell may be coloured like the rest, and the setæ may be straight or curved.

It is interesting to note that on the same batch of almond leaves, when kept moist under a bell-jar, there were developed at least nine different species of fungi, showing what a number of spores are lying dormant, just waiting for the necessary moisture to germinate and reproduce themselves. The fungi determined were :—

1. Dematium pullulans.
2. Pleospora herbarum.
3. Pyrenochæta rosella.
4. Phyllosticta prunicola.
5. Ascochyta chlorospora.
6. Kellermannia pruni.
7. Verticillium lateritium.
8. Cladosporium, sp.
9. Clasterosporium carpophilum.

This fungus seems to develop late in the season, for leaves taken from the tree early in the year required to be kept moist before the fructification appeared, while leaves and twigs examined in May and July respectively showed the fruiting fungus. The twig was the wood of one year, and was attacked by *Phyllosticta prunicola*, which disrupted the bark, and on this the fungus was found. On the leaves it occurred on definite shot-hole spots (Figs. 115, 116, and 196).

52. *Monilia olivacea.* N. sp.

Tufts compact, pulvinate, olivaceous.

Hyphæ very pale olive, transparent, septate, slightly branched, average 5 μ broad.

Conidia borne either laterally or terminally in chains on minute tooth-like projections, similarly coloured to hyphæ, elliptical, average $8\frac{1}{2}$–$10 \times 3\frac{1}{2}$–$4\ \mu$.

On fallen peach leaves affected with "curl." November, 1900. Armadale, near Melbourne.

This occurs as a saprophyte on peach leaves already dried up by the "curl" (Fig. 117).

53. *Trichoderma racemosum.* N. sp.

Forming effused, rather dense, compact patches of a pale rosy tint on both sides of leaf.

Hyphæ hyaline, slender, septate, branched, with finely granular contents, average $3\frac{1}{2}\ \mu$ broad.

Branches or fertile hyphæ, bearing short branches, arranged in a racemose manner, and bearing at their tips chains of conidia.

Conidia colourless, sometimes up to 12 in a chain, globose or subglobose, thick-walled, 8–9 μ diam.

On peach leaf. December, 1900. Armadale.

The fertile short branches may either be simple, non-septate, or they may be uni-septate, and give rise to a branchlet, also bearing a chain of conidia. The leaf was kept in a moist chamber, where the chains of conidia were fully developed (Figs. 118, 119, 120, 121).

54. *Aspergillus candidus.* Link.

Mycelium creeping, white.

Fertile branches erect, gregarious, white, without septa as a rule, 150–200 × 4–5 μ, inflated at apex into a small globose ellipsoid vesicle.

Conidia in chains, colourless, globose, 2½–3 μ diam.

On cultures of peach leaves—December, 1900. Armadale, Victoria.

This species has been recorded by Dr. Cooke in his "Hand-book" on dried plants from the Alps of New Guinea, and is now for the first time met with in Australia.

55. *Langloisula rubigo-spora.* N. sp.

Forming brown, expanded, superficial, fluffy patches on both surfaces of dead leaves, but mostly on under surface.

Hyphæ decumbent, colourless, septate, several times dichotomously branched, each ultimate branch breaking up into numerous branchlets, the tips of which are furnished with numerous spreading spine-like projections, each bearing a conidium; greatest breadth, 26 μ.

Conidia rusty-brown, elliptic to oval, thick-walled, covered with minute projections, very finely .echinulate, 27–32 × 19–23 μ, average 30 × 22 μ.

On peach leaves. January, 1901. Auckland, New Zealand.

On dead peach leaves. 1901. Victoria.

This genus, containing a solitary species, seems to come nearest the description, and the ultimate thorn-like branchlets bearing a single conidium are very characteristic.

This is quite a distinct species, and is readily recognised by the large rust-like finely echinulate spores, a character embodied in the specific name (Figs. 122, 123, 124).

56. *Hormiscium undulatum.* N. sp.

Forming blackish, projecting tufts at margin of shot-hole of leaf.

Hyphæ short, simple, septate, olive-brown, 7½ μ broad, giving off two diverging chains of conidia at apex. Chains of conidia long, wavy, sparingly, irregularly, and shortly branched, about 8 μ towards base and 12 μ towards tip, sometimes over ½ mm. long.

Conidia firmly united, dark olive-brown, cuboid to cylindric-cuboid, often developing transverse septum and occasionally one longitudinally, sometimes isodiametric, 11–15 × 10–12 μ.

On apricot-leaf with "Shot-hole." November, 1898. Nuriootpa, South Australia. (Robin.)

This genus differs principally from that of *Torula* in the chains of conidia not readily breaking up, and the long wavy chains are very characteristic of this species. It occurred on the decayed tissue at the edge of the shot-hole, and seemed to overrun it after *Phyllosticta prunicola* had destroyed it (Figs. 125, 126).

57. *Dematium pullulans.* De Bary. (Aureobasidium form.)

Forming minute, white, or yellowish, often confluent patches on upper and under surfaces of brown spot of leaf, which finally falls away, leaving a "shot-hole."

Hyphæ hyaline to olivaceous, sepate, usually not constricted at septa, branched, flexuous, generally swollen at terminal ends where conidia are borne, projecting portions very variable in length but averaging 5–6 μ broad, often forming whitish or olivaceous compact erumpent tubercles. Conidia borne terminally or laterally from the joints of the filaments, or at the ends of short lateral branches, hyaline, cylindrical or elliptical, often slightly tapering towards attached end, variable in size 6–13 × 2–4 μ.

On leaves of apricot, plum, and peach, causing "shot-hole." October, 1900. Ardmona, Victoria.

The number of conidia varied from three to seven, and they were generally more numerous on the terminal than on the lateral basidia. Detatched conidia germinate after the manner of yeast, and may give off buds at one or both ends.

On almond, apricot, cherry, peach, and plum leaves, and apricot, peach, fig, poppy, and cherry fruits. Victoria and Queensland. Vine leaves and fruit. Victoria.

Almond leaves. November, December, 1900. Myrniong and Stawell.

Apricot leaves. October, December, 1900. Armadale, Ardmona, Stawell, and Queensland.

Apricot fruit. 1899, 1901. Armadale.

Cherry leaves. Victoria. Cherry fruit. Doncaster, 1900, 1901.

Peach leaf and fruit. December, 1900. Wangaratta. Peach fruit. South Australia.

Plum leaves. October, 1900. Ardmona.

Apple leaves and fruit. Myrniong, Port Fairy, and Oakleigh.

(Figs. 127–135.)

To be read in connexion with description on p. 86, and notes on p. 162.

58. *Cercospora circumscissa.* Sacc.

Forming spots on living leaves, also less commonly on twigs and fruit.

Spots circular, pallid, dry, the dry portion at length falling out.

Hyphæ ramifying in tissue, septate, branched, averaging 3–5 μ thick, and producing a tubercular mass of thick-walled cells immediately beneath epidermis from which conidiophores arise.

Conidiophores erect, fasciculate, brownish, usually rupturing epidermis, straight or curved, often with shoulder-like projection, simple or sparsely septate, thick-walled, 14–43 μ high and 3–5 μ broad.

Conidia cylindrical but somewhat broader towards base, straight or slightly curved, yellowish to pale brownish, a-septate to 6-septate, mostly 1-4 septate, length varying between 20 and 106 μ, average 40 μ, and breadth 4–6 μ and 3–4 μ towards apex.

On both surfaces of living leaves of peach producing "shot-hole." Queensland.

But for the narrower conidia it much resembles in structure and course of development *Clasterosporium carpophilum*, Aderh. As in it the conidiophores have often a shoulder-like projection near the apex, the conidia vary considerably in size and septation according to conditions of growth, and sometimes two are produced at the same time, and finally the fungus produces on the fruit a black, circular, depressed spot.

59. *Fusarium sarcochroum.* Sacc.

On apricot leaf. December, 1900. Armadale.

This species was found on an old culture, and has already been described in connexion with Citrus diseases.

60. *Epicoccum granulatum.* Penz.

On rotting leaves of apricot, peach, and plum. December, 1900. Queensland.

This species occurred on old cultures, and has already been described and illustrated in *Hand-book of Citrus Diseases.*

61. *Capnodium armeniacæ.* Thuem.

The "sooty mould" of the apricot is of comparatively rare occurrence, and forms a black incrustation on the upper surface of the leaf, most commonly towards the tip. The pycnidial stage has only been found here, and not the problematical ascidial stage described by Thuemen, so that the exact systematic position of the fungus can only be determined by further investigation.

On apricot leaves. April, 1901. Near Melbourne. (Figs. 158, 159, 160.)

62. *Phyllosticta macrospora.* N. sp.

Spots grey or biscuit-coloured, irregular, with ruddy margin, ultimately falling away.

Perithecia on upper or under surface, black, punctiform, scattered or somewhat gregarious, slightly erumpent, depressed-globose, yellowish brown by transmitted light, membranaceous, with apical pore, $180–240\ \mu$.

Sporules colourless, cylindrical or tapering slightly towards basal end, rounded at both ends, with granular contents, $24 \times 5\frac{1}{2}–6\frac{1}{2}\ \mu$; basidia hyaline, slender, tapering to a point $9–12\ \mu$ long.

On plum leaves. April, 1901. Armadale.

On apricot leaves. April, 1901. University Gardens, Melbourne.

On cherry-plum leaves. April, 1901. University Gardens, Melbourne. (Figs. 161, 162.)

63. *Phyllosticta chlorospora.* N. sp.

Spots transversely elongated, narrow, irregular, slightly depressed, dirty-white on upper surface, pale ruddy-brown on under. Perithecia scattered, minute, black, punctiform, immersed but slightly raising epidermis, depressed globose, with slightly papillate mouth, about $150\ \mu$ diameter.

Sporules olivaceous in mass, slightly tinted individually, elongated elliptic, $3–3\frac{1}{2} \times 1\frac{1}{2}\ \mu$.

On plum leaves. April, 1901. Armadale, near Melbourne.

Adjoining this were brownish "shot-hole" spots with *Phyllosticta prunicola.*

This species approaches somewhat *Phoma armeniacæ*, Thuem., found on the fruit of the apricot, but the perithecia are few and not numerous, immersed and not semi-erumpent, and the sporules are described as sub-hyaline to greyish, $2–3 \times 1–1\frac{1}{2}\ \mu$. It is not by any means common. (Figs. 163, 164.)

64. *Camarosporium prunifolium.* N. sp.

Spots elongated, narrow, grey, with raised margin, and becoming ruptured.

Perithecia few, on upper or under surface of spot, slightly crumpent, punctiform, black, conoid, with papillate mouth, up to 200 μ diameter.

Sporules ovoid-oblong, clear brown, generally 3-septate up to 5-septate, not constricted at septa, with one longitudinal septum, occasionally two, 17–20 × 7½–8½ μ.

On Apricot leaf. April, 1901. University Gardens, Melbourne.

This species occurred on leaves still attached to the tree on greyish slit-like spots, which afterwards decayed. Not common.

It differs from *C. padi*, Brun., in the perithecia being few and not gregarious and in the sporules being generally 3-septate, and not constricted at septa. (Figs. 165, 166.)

65. *Macrosporium prunicolum.* N. sp.

Creeping hyphæ olivaceous, septate, constricted at septa, branched, forming a network, closely associated with perithecia, average 6½ μ broad.

Conidiophores tufted, smoky-brown, erect, septate, not constricted at septa, simple, paler-coloured towards apex, up to 112 × 5½ μ.

Conidia clavate, olivaceous or yellowish-green, smooth, pedicellate, 7-septate, slightly constricted at median septum, with longitudinal septa dividing it into cuboid portions, average 41–43 × 14–15 μ ; pedicel almost colourless, attaining a length of 19 μ long × 3½ μ broad.

On plum and apricot leaves, with *Gnomonia circumscissa*, causing "shot-hole." April–May, 1900. Ardmona. Also associated with *Cladosporium condylonema* and *Macrosporium commune.*

It differs from *M. uredinis* found on peach branches in the shorter conidia. (Figs. 167, 168.)

66. *Tubercularia olivacea.* N. sp.

Tubercles minute (¾ mm.), at first pulvinate then discoid, greyish or greenish, becoming dark-coloured at margin from mass of spores.

Conidiophores closely interwoven, branched, septate, pallid, slender, and bearing conidia at apex.

Conidia olivaceous in mass, almost colourless individually, cylindrical, rounded at both ends, 11–13 × 2 μ.

On decaying apricot leaves. July, 1900. Ardmona, Victoria.

The tubercle is at first whitish and ultimately becomes dark-coloured, from the mass of olivaceous spores, hence the specific name. (Figs. 169, 170.)

67. *Penicillium roseum.* Link.

Forming at first minute white tufts, gradually increasing in size and becoming pale-pink in colour.

Sterile hyphæ creeping, white, very delicate, forming a thin cobweb-like film.

Fertile hyphæ erect, loosely penicillately branched at apex, 2–3 septate, occasionally branched about middle, 3½ μ broad.

Conidia hyaline individually, mostly elliptical, occasionally inequilateral, in chains, 5–7 × 3–3½ μ.

On Plum leaf. January, 1901. Ardmona.

On Plum fruit. Bendigo.

This species occurred on leaves and fruit when kept moist under a bell jar.

The conidia were originally described as globose, 3 μ diameter, but Oudemans (quoted in Sacc. Syll. X., p. 528) gives the size of the conidia of genuine species as 5–6 × 2–2½ μ, with which the above generally agrees. (Figs. 171, 172.)

68. *Bacteriosis.*

There is every reason to suppose that in some cases, at least, bacteria produce the shot-hole effects on leaves, although the fact has not yet been proved by means of pure cultures.

In the young buds, before the leaves are expanded, innumerable bacteria are often found which may cause " shot-hole," since it is known to appear in very young leaves.

In full-grown leaves the shot-hole spots are often apparently barren, and, on keeping them moist for a few days under a bell-jar, they may develop the fructification of a fungus. But sometimes there is no such development, and bacteria alone are found, suggesting, in the absence of any other agent, that they have produced the effects.

In November and December almond, apricot, and plum leaves were met with, in which the spots were found swarming with bacteria, and in December the "soft spot" on the cherry-fruit was found to be similarly invaded.

At certain seasons of the year the apparent barrenness of the "spots" may be accounted for in this way.

69. *Volutella penicillioides.* N. sp.

Forming minute white tufts on leaf.

Sporodochium stipitate, whitish, fan-shaped, 200 μ across, furnished with elongated, pointed, hyaline, septate rigid setæ, up to 340 × 6–8 μ. Conidiophores densely crowded and branched in a Penicillium-like manner.

Conidia cylindrical, rounded at both ends, hyaline. 4–5 × 1½ μ.

On Plum leaf in moist chamber. Armadale. (Fig. 315.)

STEM AND BRANCH DISEASES.

Perhaps gumming is the most serious disease here, although it may likewise occur in leaf and fruit, and is due to a variety of causes. It is always advisable to let the gum have an outlet by slitting the bark, since if it penetrates to the interior tissues, death of the part generally ensues.

Rotting of the bark and wood may also occur through several of the so-called Bracket fungi, which produce a copious mycelium inside the tree, and thus the tissues are destroyed.

As already pointed out, there are quite a number of recognised leaf diseases which are just as much stem and branch diseases, such as peach leaf-rust and "shot-hole," and there is a risk of overlooking the fact that preventive treatment must begin before the leaves appear. Hence it is that so much stress is laid upon early spring spraying.

III. Fungi on Stems and Branches (41).

70. Schizophyllum commune.
71. Polystictus cinnabarinus.
72. Polyporus lentus.
73. Sphaerulina pruni.
74. Gibberella pulicaris.
75. Pleospora armeniacae.
76. Dendrophoma pulvis-pyrius.
77. Haplosporella pruni.
78. Diplodia malorum.
79. Dothiorella amygdali.
80. Dothiorella microspora.
81. Cytosporella armeniacae.
82. Cytospora leucostoma.
83. Botryodiplodia pruni.
    [Kellermannia pruni.]
84. Pestalozzia guepini.
85. Oospora roseo-basis.
86. Sporodesmium subcuticulare.
87. Coniothecium cerasi.
88. Coniothecium olivaceum.
89. Macrosporium commune.
90. Macrosporium persicinum.
91. Macrosporium uredinis.
92. Fusarium roseum.
93. Glutinium laevatum.
94. Botryosphaeria pruni.
95. Leptosphaeria vagabunda.
96. Schizoxylon lividum.
97. Cyphella marginata.
98. Diplodia microsporella.
99. Fusicoccum microspermum.
100. Hendersonia persicae.
101. Cornularia piriformis.
102. Rhabdospora corticola.

103. Brachysporium excorians.
104. Coniothecium albo-cinctum.
105. Dictyosporium elegans.
106. Rebentischia massalongi.
107. Acanthostigma curvisetum.
108. Didymella fusispora.
109. Didymosphaeria cerasorum.
110. Phoma persicae.

70. *Schizophyllum commune.* Fries.

Pileus very thin, fan-shaped, white or grey, downy, often lobed, 1–2 inches broad.

Gills pale-brown with a purple tinge, split portions of edge of gills revolute.

Spores dingy, 4–6 × 2–3 μ.

On apricot tree along with *Polystictus cinnabarinus.* June, 1900. Armadale, near Melbourne.

This fungus has been recorded as a parasite on mulberry-trees in France, and on stems of sugar-cane in the West Indies, but there was nothing to indicate its parasitic nature in this instance. I have generally found it on dead wood (Pl. X.).

71. *Polystictus cinnabarinus.* Fries.

Pileus corky, convexo-plane, a little zoned, rugulose, pubescent, becoming smooth, vermilion, turning pale, internally floccose and darker.

Pores round, of medium size, bright vermilion.

Spores hyaline, elongated elliptical, slightly granular, 4½–5 × 2 μ.

On apricot stem and branches. May–June, 1900. Armadale, near Melbourne.

On cherry stem and branches. May, 1900. Christmas Hills, Victoria.

The sporophores are generally bracket-shaped, and they may become confluent and overlap, or they may form irregular masses bursting through the bark. They vary in colour from a deep orange vermilion to pallid, and the lower tube-bearing surface is always of a deeper vermilion. The size is variable. They may reach 4 inches in width and project at least 2¼ inches. The pores are roundish, but inclined to be irregular, and the tubes are about 2 mm. in depth.

On examining one of the largest pilei on the apricot tree a year afterwards it was found to have increased considerably in diameter. The bright vermilion band of growth round the margin stood out distinctly from the greyish bark-like colour of the old growth, and was 10 to 12 mm. across, or about half-an-inch (Pl. IX., X.).

72. *Polyporus lentus.* Berk.

Pileus 1–1½ inches across, thin, tough, coriaceous, rigid, umbilicate, dark-brown, zoned towards the dark almost black margin, which is incurved, smooth but cuticle often cracking in radiating lines from umbilicus and exposing white flesh.

Pores tawny, up to 2 mm. deep, large, angular, elongated radially, decurrent ; dissepiments thin and often toothed. Stem central, or nearly so, round or usually somewhat flattened, brownish and generally same colour or paler at base, hispid particularly on upper part, straight or slightly curved, about $\frac{3}{4}$ inch long by $\frac{3}{8}$ inch across. Spores hyaline, elongated elliptical, with granular contents, average 8 × 3 μ.

On stem of living apricot tree. October, 1900. Hawthorn, near Melbourne.

The stem was imbedded in the bark by a dense white mycelium, and killed the portion to which it was attached.

The spores are rather smaller than the type where they are given as 12 × 4–5 μ (Pl. X.).

73. *Sphærulina pruni.* N. sp.

Perithecia minute, black, shining, punctiform, scattered, at first covered, then erumpent, globose, brown by transmitted light, membranaceous, tough, about 120 μ diameter, with slightly papilliform mouth, seated on silvery-grey streaks of the bark.

Asci shortly stalked, elongated oblong, 8-spored, without paraphyses, equal in breadth throughout, 45–50 × 10 μ.

Sporidia 2-rowed, hyaline, elongated-ovate, straight, 3-septate, not constricted at septa, constant in size, 15–16 × $4\frac{1}{2}$–5 μ.

On dead twigs of almond. August, 1900. Myrniong, Victoria.

This is quite a distinct species, and the only member of the genus recorded on stone fruit trees. It differs from *S. intermixta*, Sacc., found on rose and bramble twigs, in the perithecia not being covered by the cuticle, and the sporidia being always straight not constricted at the septa and narrower (Figs. 173, 174, 175).

74. *Gibberella pulicaris.* Sacc.

Black erumpent pustules on dead apricot twigs.

Perithecia crowded, superficial, purplish.

Asci oblong, sessile or shortly stalked 8-spored, 60–75 × 12–16 μ,

Sporidia 2-rowed, colourless, or with very faint tinge of yellow, sub-fusoid, 3-septate, occasionally constricted at septum, straight or somewhat curved, contents granular, 18–20 × 6–8 μ.

Associated with a species of *Fusarium*, on which the conidia are colourless, slightly curved, fusiform, acute at both ends, 3-septate, not constricted at septa and averaging 28 × $2\frac{1}{2}$–3 μ.

On apricot twigs. July, 1900. University Gardens, Melbourne.

75. *Pleospora armeniacae.* N. sp.

Perithecia scattered, at first covered, then erumpent, coriaceous, firm, with sometimes somewhat elongated ostiolum, black, reaching about 500 μ diameter.

Asci cylindric, stipitate, rounded at apex, 8-spored, 100–108 × 9–10 μ.

Paraphyses hyaline, with finely granular contents, $1\frac{1}{2}$–2 μ broad.

Sporidia uniseriate, olivaceous, elongated oblong to elongated elliptical, 3 transverse septa, and slightly constricted at median septum, but hardly constricted elsewhere, with two median longitudinal septa, 17–19 × $6\frac{1}{2}$–$7\frac{1}{2}$ μ.

On dead twigs of apricot. June, 1900. Armadale, Victoria.

Occasionally there is a cushion of densely compacted olivaceous hyphae, on which the perithecia rest. It differs from *P. permunda* in the larger perithecia, the much narrower asci and the uniseriate sporidia, which are smaller (Figs. 176, 177, 178).

76. *Dendrophoma pulvis-pyrius.* Sacc.

Perithecia depressed-globose, scattered, minute, punctiform, black, erumpent, membranaceous, with apical pore, 120–150 μ diameter.

Sporules very numerous, hyaline, cylindrical, rounded at both ends, $3\frac{1}{2}$–4 × ·75–1 μ ; basidia hyaline, slender, elongated, branched.

On dead twigs of almond, apricot, peach, plum, and apple. Victoria and South Australia.

This species was originally found on the wood and bark of *Pyrus* and other trees in Italy and France. It is one of our common species (Figs. 179, 180).

77. *Haplosporella pruni.* N. sp.

Stroma black, slightly convex, at first covered, then erumpent, bark wrinkled.

Perithecia 2–3 aggregated together, globose, sub-carbonaceous, with apical pore, 500–600 μ diameter.

Sporules oblong, continuous, smoky-brown, 22–24 × 13–15 μ.

On living branches of plum, ultimately killing it. May–July, 1900, Armadale.

On apricot branch, causing large warted swellings. July, 1900, Armadale.

In the few perithecia aggregated together, only one obtains the full size, the other one or two being considerably smaller.

The plum tree on which the species was found had been badly attacked by "Shot-hole." Towards the base of the twig the tissue was healthy and green, and the bark smooth, but where the fungus occurred, the tissues were dead, and the bark much wrinkled (Figs. 181, 182).

78. *Diplodia malorum.* Fckl.

Perithecia either scattered or loosely gregarious, very numerous, black, at first covered then erumpent; depressed globose, of parenchymatous texture, with distinct apical pore about 400 μ diameter.

Sporules oblong, smoky-brown, 1-septate, slightly constricted at septum, twice as long as broad, 22–26 × 11–13 μ.

On dead twigs of peach, plum, and cherry-plum. May–July, 1900. Armadale and University Gardens, Melbourne.

On dead twigs of plum. Ardmona.

On dry withered shoots of the peach, the superficial layer of the bark becomes a silvery-grey, and peels off in flakes.

It differs from *D. pruni*, Fckl. in the perithecia being almost exclusively solitary, and not aggregated in groups of 5 to 8. A large number of specimens were examined from peach, plum, and cherry-plum, and all possessed the same characters. Further *D. pruni* is very common on apricot branches, and although plenty of material was examined no Diplodia was found there. It approaches *D. tecta*, B. and Br., in the size and shape of the sporules, but has not the gregarious and covered perithecia blackening the cuticle. This species has only hitherto been recorded for decaying apples and pears. (Figs. 183, 184).

79. *Dothiorella amygdali.* Cooke and Mass.

Perithecia innate, botryose, transversely erumpent, black, opaque, not papillate, rather gelatinous when moist.

Sporules elliptical, hyaline, granular within, 22–25 × 8–10 μ, on rather thick basidia of equal length.

On bark of peach and almond. Victoria.

On young dead shoot of peach. December, 1900. Auckland, New Zealand (Figs. 185, 186, 187).

80. *Dothiorella microspora.* N. sp.

Forming conspicuous black, erumpent, hemispherical masses about 1 mm. in size, sometimes confluent and causing transverse fissures in bark.

Perithecia imbedded in stromata in clusters or standing out individually, deep ruddy-brown by transmitted light, paler within, coriaceous, when solitary and outstanding elliptical in shape, 200 × 160 μ.

Sporules olivaceous in mass, hyaline individually, elliptical, minute, 3½–4½ × 2–2½ μ.

On dead and fallen twigs of apricot. July, 1900. Armadale, Victoria (Figs. 188, 189, 190).

81. *Cytosporella armeniacae.* N. sp.

Perithecia imbedded in black swellings on dead twig, dark-brown by transmitted light, depressed globose, plurilocular, dark-green within.

Sporules extremely copious, elongated elliptical, straight, hyaline, minute, 3½–4 × 1¼ μ; basidia arising from green base and slightly coloured, filamentous, septate, up to 15 μ long.

On dead twigs of apricot. July, 1900. University Gardens, Melbourne (Fig. 191).

82. *Cytospora leucostoma.* Sacc.

Stromata black, subglobose, scattered, with apex piercing raised cortex, internally divided into several cavities, about ½ mm. in diameter.

Sporules hyaline, cylindrical, rounded at both ends, generally curved but occasionally straight, 5½–7½, 1–1½ μ, oozing out in reddish curls when moist; basidia hyaline, septate (2-septa) tapering towards apex, variable in length but reaching 20 × 2 μ, and only about half the breadth of sporule at apex, arising from dark-green base.

On almond branch. January, 1900. Phillip Island.

Peach branch. May and July, 1900. Armadale.

Plum branch. May, 1900. Armadale.

Cherry-plum branch. July, 1900. Near Melbourne.

When dry the stromata are tipped with dirty white, due to the presence of crystals, but after moistening the sporules ooze out in long reddish tendrils shown in plate (Pl. VI., Fig. 2 and Figs. 192, 193, 312).

83. *Botryodiplodia pruni.* N. sp.

Forming large erumpent masses with 4-5 perithecia imbedded in the stromata.

Perithecia black, depressed globose, of parenchymatous texture, with distinct apical pore 350–400 μ.

Sporules dark-brown, oblong, rounded at both ends, sometimes slightly tapering towards one end, 1-septate (very rarely 2 or 3-septate), occasionally slightly constricted at septum, thick-walled, variable in size 24–32 × 9–12 μ, average 28 × 11 μ.

On apricot branch. July, 1900. Armadale.
Plum branch. September, 1899. Ardmona.
June, 1900. Armadale.

In the Ardmona specimens the dead wood was found lying on the ground, while in the Armadale specimens the twigs were cut from the tree. The end of the twig where the perithecia occurred was dead, but so closely adjoining the still living part that it was strongly suggestive of parasitism (Figs. 194, 195).

84. *Pestalozzia guepini.* Desm.

Pustules scattered, minute, punctiform, black, convex, at first covered then erumpent by the splitting of the epidermis.

Conidia fusiform, 4-celled, 2 median cells golden-brown, terminal cells, conoid and hyaline, $21–23 \times 7\frac{1}{2}–8\ \mu$, crested generally with three divergent, sometimes branched setae, but may be 2 or 4, up to $32 \times 1\ \mu$; basidia hyaline, slender, about length of conidium and often persistent.

On dead almond leaves and twigs. April and June, 1898. Ardmona, Victoria.

On living peach leaves. March, 1901. Near Bunyip, Victoria.

Intermixed with the ordinary conidia were others in which the brown median cells were globose or subglobose, the upper generally larger than the lower and about $9\ \mu$ in diameter, while the colourless cells at either end were very much reduced and the setae had disappeared. Most of these conidia were either begining or had actually germinated, putting forth a colourless, branched, sparingly septate, germ-tube, laterally from one or both cells. It would appear that only the coloured cells germinate and when this takes place the setae are no longer necessary (Figs. 197, 198).

85. *Oospora roseo-basis.* N. sp.

Forming a discoloured patch on old wound of dead shoot. Mycelium composed of closely jointed hyphae aggregated together to form a pavement, decidedly ruddy in tint and detaching at margin innumerable conidia.

Conidia hyaline, variable in size and shape, but generally elongated elliptical, in short chains, $5–11 \times 2–5\ \mu$, average $7 \times 3\frac{1}{2}\ \mu$.

On dead shoot of peach. July, 1900. Adelaide, South Australia.

It is difficult to place this species, as it seems to consist simply of numerous cells agglutinated together and giving off innumerable conidia, but it approaches nearest to *Oospora*, hence its position (Figs. 199, 200).

86. *Sporodesmium subcuticulare.* N. sp.

Tufts minute, black, sometimes coalescing, subcuticular. Mycelium generally scanty, composed of creeping, pale olive, branching, septate hyphae, average $3\ \mu$ broad.

Conidia very abundant, sooty brown, elliptic to oblong, 1–3 septate not or very slightly constricted at septum, with longitudinal septa in one division or in all, $11–14 \times 8–9\ \mu$.

On dead apricot twig. June 1900. Armadale, near Melbourne.

The conidia may be 1 septate and then a longitudinal septum may only be in one division or in both, forming a Maltese cross; when there are two or three transverse septa, the longitudinal may be in one or all the divisions (Figs. 201, 202.)

87. *Coniothecium cerasi.* N. sp.

Forming blackish patches on branches of cherry where gumming is taking place, and the corky layer is slightly ruptured.

Hyphæ of a yellowish-green originating from colourless cells, and composed of irregularly shaped segments, which run in lines and blend into masses and produce the darker coloured mulberry-like clusters of spherical cells; the breadth varies from 5–10 μ.

Cells of the mulberry-like clusters, may divide and subdivide and detach as variously shaped smaller groups of cells.

On branches of cherry dying or dead, associated with "gumming." October, 1898. Campbell's Creek, Victoria (Cock).

The hyphæ are in abeyance, and the mulberry-like clusters are the most prominent feature. They are sometimes quite globular, and consist of spherical cells, averaging 9–10 μ in diam., agglutinated together.

Underlying the yellowish-green cells, and possibly an earlier stage of the same fungus, are short colourless hyphæ bearing hyaline, continuous, elliptic, minute conidia, 4–6 × 2–2½ μ (Fig. 203).

88. *Coniothecium olivaceum.* N. sp.

Forming olivaceous effused layer at junction of branch and twig of dead peach.

Colourless pavement of small coalesced, polygonal cells, bearing mulberry-like clusters of conidia.

Conidia dark olive, sessile, oblong, cruciately septate, 13–17 × 9–12 μ on an average, but very variable in size, and clustered into large irregular masses.

On dead shoot of peach. July, 1900. Adelaide, South Australia. The young peach trees (about eighteen months old) from which this specimen was taken showed signs of decay, and ultimately the shoots died, but this fungus was evidently a saprophyte. (Fig. 204.)

89. *Macrosporium commune.* Rabh.

On dead plum twigs from Ardmona.

On dead almond leaves from Myrniong.

On dead apricot leaves from Armadale.

Common on cultures of leaves from various districts. (Figs. 205, 206.)

90. *Macrosporium persicinum.* N. sp.

Forming very minute, black, punctiform tufts, bursting through, and generally distributed all over the brown outer cortex.

Mycelium consisting of creeping and projecting hyphæ. Creeping hyphæ pale-greenish, septate, much branched, ramifying in all directions, about 5 μ broad. Projecting hyphæ yellowish-green to brownish, sparingly branched, septate, segments elongated, moniliform, average 5½ μ broad.

Conidia oblong, somewhat tapering towards point of attachment, usually 3-septate, constricted at septa, and one longitudinal septum often in each division, average 19 × 10 μ.

Various conidia were associated with this form, and may represent different stages of the same fungus.

Cladosporium.—Conidia terminal or lateral, occasionally in chains, smooth, generally 1-septate, constricted at septum, elliptical or oblong, thick-walled, 11–16 × 6½–10 μ.

Helminthosporium.—Conidia generally brownish, smooth, thick-walled, oblong, 2-3-septate, deeply constricted at septa, 28–36 × 13–19 μ.

Coniothecium.—Conidia springing from basal stroma, brownish, generally cruciate, 10–13 × 9–11 μ. On living branches of peach tree. December, 1899. Eltham, Kinglake, Diamond Creek, &c, Victoria. (Meeking.)

The Cladosporium-form was the most common. This fungus causes the still living and green cortical tissue to become brown, and ultimately kills the twig. In the early spring the disease does most damage, as the fruit-bud is invariably shed, and severe gumming takes place there. How far spring frosts may contribute towards this result I have not determined. (Figs. 207, 208, 209, 210.)

91. *Macrosporium uredinis.* Ell. & Bart.

At first a greyish coating on ruptured pustule of *Puccinia pruni*, finally a dusky dark greenish coating.

Hyphæ olivaceous, septate, branched, densely interwoven, average 4½ μ broad.

Conidia clavate, tapering towards base, clear olive-brown, generally 7-septate, variable in length and breadth, 47–56 × 18 μ.

Associated with this were colourless and Cladosporium forms, probably early stages of the mature form.

Colourless form. — Hyphæ hyaline, slender, septate, densely crowded.

Conidia terminal, hyaline, elliptical, 5½–7 × 2½–3 μ.

Cladosporium form. — Creeping hyphæ olivaceous, septate, branched, much intermixed, about 5½ μ broad ; erect hyphæ olivaceous at base, but pallid, even, hyaline towards apex, non-septate, about 75 μ high and 4½ μ broad towards base, slightly tapering towards apex.

Conidia terminal, at first hyaline, continuous and fusiform, with finely granular contents, finally 2-septate, pale-greenish, rounded at both ends, 17–21 × 5–5½ μ.

On peach branch. October, 1898. Healesville (Cronin).

The three stages are so intimately associated that I have preferred to include them under one designation rather than multiply species. As far as one can judge without artificial cultures, the fungus starts from colourless hyphæ producing innumerable colourless conidia, then longer conidiophores, green at the base at least, are formed, producing pale-green conidia which are 2-septate when mature, and finally the Macrosporium-stage appears with stout hardy conidia, some of which were found germinating *in situ.* This species was first found parasitic on the uredo stage of *Puccinia graminis.* (Figs. 211, 212.)

92. *Fusarium roseum.* Link.

Sporodochia erumpent, reaching 2mm. diameter, pulvinate, compact, waxy, gregarious, often confluent, reddish.

Hyphæ densely fasciculate, hyaline, ruddy in mass, septate.

Conidia produced at tips of branches, straight or curved, fusiform, granular contents, typically 3-septate, may be 1-septate or 5-septate, 24–42 × 3–4½ μ, average 30 × 4 μ.

On dead branches of plum and apricot, also on dead apricot leaves. Ardmona, Victoria.

On apricot leaves. December, 1900. Armadale, Victoria.

This was a very striking species, and produced in quantity on twigs and branches. It occurred most plentifully about August and September. It was found on the same twig along with *Diplodia malorum*, Fckl. It may also be overrun by dark olivaceous Macrosporium-like fungi.

The Armadale specimens on apricot leaves were developed in a moist chamber in the form of pink tufts, and the conidia were generally 3-septate, and averaged 28 × 4 μ. (Figs. 213, 214).

93. *Glutinium lævatum.* Starb.

Perithecia dark-olivaceous, projecting, few, wall composed of a dense mass of interwoven hyphæ, without evident mouth, about 200 μ across.

Sporules hyaline, rod-like, straight or slightly curved, 3½ × 1 μ; basidia long, filamentous, almost hyaline, 18–22 × 1 μ.

Permeating the gum and surrounding the perithecia are numerous hyaline, slender, branched, septate hyphæ, usually broken up into detached fragments.

On gumming peach twigs. June, 1900. Armadale, near Melbourne.

Only a few perithecia were found imbedded in the gum, and they were very characteristic. The walls were seen to be composed of distinct interlacing filaments, and of a primitive type, while the sporules were produced on long hyphæ projecting into the interior.

The spores in the type specimen were 5–7 × 1½–2 μ, and occurred on *Prunus padus.* This genus is of the nature of a *Phoma*, but the walls of the perithecium are composed of interlacing hyphæ. (Figs. 215, 216).

94. *Botryosphaeria pruni.* N. sp.

Stromata densely gregarious, giving a roughened appearance to the bark, pulvinate, black, rupturing bark transversely, up to 1 mm. across.

Perithecia several together (4–5), globose to depressed globose, with prominent papillæ or even beaked, sub-coriaceous, 300–400μ diameter.

Asci clavate or elongated cylindrical, paraphysate, 8-spored, 40–80 × 13–16μ.

Paraphyses hyaline, septate, filiform, slightly longer than ascus.

Sporidia bi-seriate, or uni-seriate, hyaline, elongated elliptical to lanceolate elliptical, with finely granular contents, 20–24 × 8–9μ.

On dead apricot twig. June-July, 1900. Armadale, near Melbourne.

On dead plum twig. July, 1900. University Gardens, Melbourne. Associated with *Cytosporella armeniacae*, n. sp.

It differs from *B. cerasi*, Sacc., principally in the size and shape of the sporidia, which are 25 × 12–14μ, and from *B. pruni-spinosae*, Delacr., where the asci are much larger, and the sporidia 25–33 × 12μ. The asci may be shortly clavate or elongated cylindrical in the same group. They seem to be very evanescent, and perithecia are often found with only a trace of asci and yet full of spores. When the spores are thus free from the ascus, it might readily be mistaken for *Dothiorella amygdali*, Cooke, and the danger of confusion is increased from the fact that both are found occasionally growing alongside of each other on the same stroma, hence they are probably genetically connected. (Figs. 217, 218, 219, 220).

95. *Leptosphæria vagabunda.* Sacc.

Perithecia nestling in bark, covered by the epidermis, globose, black, scattered or crowded, with a small and only slightly projecting mouth, 200–500μ diameter.

Asci clavate-cylindrical, short-stipitate, 8-spored, with abundant filiform paraphyses.

Sporidia two-rowed, fusoid, at first hyaline and 4-guttulate, then uniseptate and constricted, finally 3-septate, sooty-brown, constricted at all the septa, but deeply at median, rounded at both ends and often with an oil-globule in each cell, 19–26 × 6–7½μ.

On dead peach branch and on trunks. March, 1901. Armadale.

This is a widely distributed species and occurs on a large number of host-plants. It was found in a fissure on the dead branch of peach.

It differs from *L. pomona*, Sacc., which is regarded by Saccardo as the ascidial form of *Phyllosticta prunicola*, Sacc., in the larger perithecia, and in the sporidia being smaller and only 3-septate, not 5–6 septate (Figs. 221, 222, 223).

96. *Schizoxylon lividum.* N. sp.

Scattered or sub-gregarious, ascophore ¾-1mm. diameter, bursting through epidermis and becoming superficial; disc white and gelatinous when moist, grey when dry, concave, surrounded by dark raised margin.

Asci elongated-cylindrical, slightly tapering towards base, 180–200 × 10μ.

Sporidia 8, filiform, very slender, hyaline, multi-septate, nearly as long as the ascus, breaking up into joints at the septa, each joint measuring 3–3½ × 1½–2.

Paraphysis filiform, much longer than the asci, septate, repeatedly branched in a furcate manner, and branches often thickened at apex.

On dead peach twigs. March, 1901. Armadale, near Melbourne.

There is a *S. bagnisianum*, var. *minus*, Speg., on fallen twigs of *Prunus domestica*, already recorded from Argentina, but it differs from the above and the spores are 5–6 × 2–3μ.

The specific name is given from the leaden colour of the disc (Figs. 224, 225, 226, 227, 228).

97. *Cyphella marginata.* N. sp.

Sub-gregarious, ochraceous, cup-shaped, erect, very shortly stalked, membranaceous to stiff gelatinous, margin of cup villose, with numerous incurved, honey-coloured hairs, generally resembling a *Peziza*, ½–1 mm. in diameter.

Hymenium slightly concave, creamy white.

Spores hyaline, sub-globose to sub-elliptical, 8–9μ diameter, or 11–12 × 8μ; basidia elongated-clavate, hyaline, tetrasporous.

On dead peach twigs, along with *Schizoxylon lividum.* March, 1901. Armadale, near Melbourne.

It differs from *C. villosa*, Karst., in the cups being shortly stalked and not sessile, in the hairs being marginal and honey-coloured, and not covering the whole with a snow-white down, and in the basidia being clavate and not fusoid.

The specific name is given from the margin being fringed with hairs (Figs. 229, 230, 231, 232).

98. *Diplodia microsporella.* Sacc.

Perithecia loosely gregarious, covered by swollen epidermis, then erumpent, globular, depressed papillate, sub-carbonaceous, 90–95 μ. Sporules brown, oblong, 1-septate, often constricted at septum, 10–11 × 4½–5½ μ.

On dead peach twigs. December, 1896. Burnley, near Melbourne.

On peach-leaf culture affected with "Shot-hole."

This species is already recorded on dead branches of plum (Figs. 233, 234).

99. *Fusicoccum microspermum.* Har. and Karst.

Stromata solitary or concrescent, erumpent to superficial, warty or pulvinate, coriaceous to carbonaceous, plurilocular within, 2–3 mm. broad.

Sporules bacilliform, hyaline, 3 × ·75 μ.

Basidia filiform, septate, often alternately branched.

On dead branches of plum. June, 1897. Burnley, near Melbourne.

On dead branches of apricot. June, 1900. Armadale.

This species was originally found on *Terminalia*, in Ceylon (Fig. 235).

100. *Hendersonia persicae.* N. sp.

Perithecia at first immersed, then erumpent, scattered, numerous, black, sub-carbonaceous, globose, with apical pore, average 350 μ diameter.

Sporules numerous, entirely dark-brown, 3-septate, not constricted at septa, ellipsoid to oblong, 15–19 × 6–7½ μ; basidia not visible.

On dead peach twigs. December, 1900, Port Fairy, and March, 1901, Armadale.

This species differs from *H. sarmentorum*, West, in the longer and broader sporules, and from *H. vagans*, Fckl., in the sporules not being long-stalked nor yellow.

H. foliorum, Fckl., found on plum leaves differs in having the sporules long-pedicelled, somewhat curved, yellow, and the ultimate segment hyaline, although the size is about the same. In the Armadale specimens the sporules were rather narrower and more transparent, but otherwise agreed (Figs. 236, 237).

101. *Cornularia piriformis.* N. sp.

Perithecia black, erumpent, pear-shaped, membranaceous, of parenchymatous texture, about 100 μ diameter.

Sporules hyaline, slender, elongated, curved, acute at both ends and broadest at middle, with finely granular contents, 3–5 septate, 56–64 × 2 μ, average length 58 μ, and may attain a length of 75 μ: olivaceous slender filaments of equal thickness throughout, and generally 3-septate, arise from the same base as the sporules and surround them, forming a rostrum.

On dead peach branch. March, 1901. Armadale, near Melbourne.

C. persicae, Sacc., was found on peach and cherry branches in North America, but the sporules were 7–8 septate, guttulate, olive, and 60–70 × 3–3½ μ (Figs. 238, 239, 240).

102. *Rhabdospora corticola.* N. sp.

Minute black punctiform pustules on greyish patches of bark. Perithecia dark brown, superficial, depressed-globose, scattered or loosely gregarious, with distinct apical pore, averaging 80 μ diameter. Sporules hyaline, fusiform, crescent-shaped, acute at both ends, non-septate, occasionally guttulate, 18–22 × 1½–1¾ μ.

On apricot and peach branch. January, 1901. Armadale, Victoria.

It occurred on the growing bark where a wound had previously been.

This species differs from *R. persica*, Sacc., in which the sporules are septate and constricted at the septa, and from *R. pruni*, Syd., in the superficial and much smaller perithecia, and in the sporules being crescent-shaped and acute at both ends (Figs. 241, 242).

103. *Brachysporium excorians.* N. sp.

Forming a dense, black incrustation on fissure of bark of branch, consisting of irregular oblong or rounded masses, which are readily peeled off. Creeping hyphæ dark-brown, sinuous, septate, not constricted at septa, branched, average 4½ μ broad. Upright hyphæ transparent-brown, rigid, simple or one branched, septate, constricted at septa, about same breadth as creeping hyphæ.

Conidia borne at apex, sometimes obliquely, 1-2 septate, often slightly constricted at septa, elongated elliptic to oblong, clear brown, 11–15 × 4–5½ μ.

On peach branch. March, 1901. Armadale.

The black irregular masses lining the fissure look not unlike excreta, and have a very characteristic appearance. *Clasterosporium carpophilum* also occurred on the same patch (Figs. 243, 244).

104. *Coniothecium albo-cinctum.* Preuss.

Tufts minute, black, sub-gregarious, at first covered, then erumpent, compact, punctiform, readily detatched, seated on grey patches, which usually run together along the shoot, olive-brown in masses by transmitted light and olivaceous when spread out, about 130 μ diameter. Delicate hyaline stroma and occasional short hyphæ either slender and hyaline or pale olive, septate, and about 3½ μ diameter.

Conidia clustered together in compact masses, olivaceous, variable in size and shape, sub-globose, and reaching 20 μ diameter, or often apparently 3-celled, epispore black, about 13 μ or 15 × 10 μ.

On living leafy shoots; also on dead leafless shoots of plum and peach. Summer and autumn, 1901. Armadale, Victoria.

This species has already been found on the bark of the apple in Germany.

The young healthy shoots of the plum exhibit on the sides exposed to the light greyish patches which usually run together into continuous areas, and are dotted all over with the minute black points which are erumpent and readily fall away. It is a very common parasite on the plum, although it does not seem to do much damage (Fig. 245).

105. *Dictyosporium elegans.* Corda.

Growing on wood. Tufts effused, black.

Mycelium only represented by a hyaline, or coloured, slender, short filament, tapering towards base, 9½ × 1½ μ.

Conidia tongue-shaped, apex acute or rounded, rarely more or less contracted at the centre, base attenuated or cordate, cells diaphanous, yellowish-brown, 4–5 rows, walls rather thick, brown or blackish, 57–60 μ long; individual cells somewhat cuboid, about 5½ μ broad.

On dead peach branch. 1901. Armadale (Figs. 246, 247).

106. *Rebentischia massalongi.* Sacc.

Perithecia gregarious, superficial, black, shining, subcarbonaceous, globose, with papillate mouth, about ¼ mm. in diam.

Asci clavate, attenuated towards base, 8-spored, 75 × 11 μ, with very numerous, slender paraphyses crowded together, and considerably longer than asci. Sporidia caudate-pyriform, 3-septate, straight or often curved, slightly constricted at septa, olivaceous, with basal segment hyaline, 30–35 × 5½–7½ μ.

On dead Apricot bark. June 1901. Armadale.

The sporidia at first are 1-septate, and the upper coloured portion is distinctly marked off from the colourless caudate portion, which narrows suddenly and tapers to a point. I have assigned this species to the above, found on almond-trunks in Italy, although the paraphyses are said to be obsolete, and the asci and sporidia are much narrower. (Figs. 248, 249, 250.)

107. *Acanthostigma curvisetum.* N. sp.

Perithecia scattered, superficial, black, globose, membranaceous, tough, with apical pore, and covered with dark-brown slightly curved bristles, 180-200 μ diam; bristles up to 38 μ long and tapering towards apex.

Asci clavate to elongated clavate, tapering into short stalk at base, 8-spored, with slender, filiform paraphyses longer than asci, 65–85 × 11-19 μ; contents stained rust colour with Schulze's solution.

Sporidia conglobate, hyaline, cylindric-fusoid, slightly curved, acute at both ends, multi-septate (up to 14), guttulate, 56–60 × 5–5½ μ; stained pale-green by Schulze's solution.

On dead Apricot bark. June, 1901. Armadale.

The perithecia occur on the ruptured and wrinkled bark, and the asci vary in length and breadth, some being relatively short and stout, others longer and narrower.

It differs from *A. perpusillum*, De Not., found on the interior bark of the cherry in Italy, in which the sporidia are only 5-septate, slightly constricted and half the length. (Figs. 251, 252, 253, 254.)

108. *Didymella fusispora n. sp.*

Perithecia scattered, minute, black, erumpent, globose, membranaceous, at first beneath epidermis, erumpent and becoming almost superficial, with apical pore, 120–150 μ diam.

Asci oblong, with short pointed base, 8-spored, 34–37 × 13 μ; paraphyses numerous, slender, filiform, septate, longer than asci.

Sporidia conglobate, hyaline, fusiform, slightly curved, 1-septate, generally acute at both ends, not constricted at septum, 26–28 × 3½–4 μ.

On dead apricot bark, June, 1900. Armadale.

It occurred on the smooth bark, and not on the ruptured and wrinkled portions, like the other fungi found at the same time.

It differs from *D. prunicola*, Fautr. and Lamb., found on the branches of *Prunus spinosa* in France, in which the asci are cylindrical, and 140 μ long, and the sporidia are monostichous and 18–20 × 9-10 μ. (Figs. 255, 256, 257.)

109. *Didymosphæria cerasorum.* Sacc.

Perithecia scattered, black, erumpent, becoming almost superficial, ⅓–½ mm. diam.

Asci elongated, narrow, rounded at apex, tapering at base, 116–120 μ × 11–12 μ.

Sporidia olivaceous, monostichous, elliptic-oblong, to elliptic-fusoid, obtuse at both ends, straight, or sometimes slightly curved, 1-septate, not or occasionally very slightly constricted at septum, 21–24 × 7½–9½ μ.

Paraphyses hyaline, slender, rounded at apex, septate, longer than ascus, 2½–3 μ broad.

On dead Apricot bark. May, &c., 1901. Armadale.

Saccardo has made a new sub-species, *D. padina*, which differs from the type in the slightly larger and more obtuse sporidia, but the above agrees sufficiently well with the original species. (Figs. 258, 259.)

110. *Phoma persicæ.* Sacc.

Perithecia numerous, gregarious, punctiform, black, immersed, elevating cortex, globose, membranaceous, opening at surface, 200–270 μ diam.

Sporules numerous, hyaline, elliptic, 6–7 × 3 μ.

On Peach twigs. September, 1901. Arthur's Creek, Victoria.

This fungus generally affects the vicinity of the buds, and gives the bark a dirty or ruddy-grey appearance. It apparently causes the death of the twigs, or "dying back," as the grower called it. (Figs. 270, 271, 272, 273.)

ROOT DISEASES.

The only serious disease met with on the root is caused by a dense white mould which overspreads the fibrous roots as well as the delicate feeding fibres, and soon causes their decay and death. This has only been found on the roots of the cherry, but probably occurs on other members of the family.

It is the mycelium of an agaric which has already been recorded on the roots of the raspberry, and has seriously interfered with that industry in the Wandin Yallock district. The fungus will probably attack the roots of our various fruit trees, and therefore care should be taken not to plant in soil where the fungus already occurs. I have found it passing from decayed and decaying roots in the soil to healthy roots, and the common mistake of planting at once in virgin soil should be avoided. The land should be cropped, and the dead roots, &c., in the soil brought to the surface and burnt off, so that the moulds on decaying vegetable matter may be removed as far as possible.

A *Phoma* was also found on the dead roots of peach trees attacked by the root-borer, but there was no evidence to show that it attacked healthy roots.

[While these sheets were passing through the press the Honey Agaric, *Armillaria mellea*, was found on roots of apricot from Shepparton.]

FUNGI ON ROOTS (7).

111. Hypholoma fasciculare.
112. Cylindrium intermixtum.
113. Verticillium candidulum.
114. Coniosporium radicicolum.
115. Phoma radicicola.
116. Pyrenochæta radicina.
117. Armillaria mellea.

111. *Hypholoma fasciculare.* Huds.

Gregarious, growing in tufts, intensely bitter.

Pileus fleshy, firm, smooth, golden-brown, cuticle cracking on drying and exposing yellowish flesh, convex, slightly umbonate, margin a little incurved, varying from $\frac{1}{8}$ to $\frac{3}{4}$ inch in diameter.

Stem central, firm, tough, creamy white, elastic, without ring, generally same thickness throughout, stuffed, becoming hollow, varying in length from 2 inches downwards.

Gills pale green, crowded, adnate, bifurcating.

Spores brown, oval to ovate, 6–7 × 4 μ.

On roots of cherry. May, 1899. Wandin Yallock, Victoria.

This fungus has already been found on raspberry roots in the same district, causing them to decay. The perfect form is met with about August.

The cherry roots were covered with a dense white mould, which is very characteristic, and it soon overspreads the fibrous roots, completely destroying them.

112. *Cylindrium intermixtum.* N. sp.

Forming thin, white, pulverulent patches, intermixed with other fungi.

Conidia concatenate, elongated cylindrical, obtuse at both ends and often rounded, sometimes bi-guttulate, colourless or smoky-brown, average 17 × 4–5 μ, but may be twice that length.

On bark of apricot. Ardmona, Victoria.

This species was intermixed with *Coniosporium radicicolum* and *Verticillium candidulum,* both on the bark of trunk and root. The conidia were fairly constant in shape, but variable in length and very numerous. It differs from *C. Cordae,* Sacc., in the conidia being often coloured, and in the comparatively few species recorded there are none agreeing with this one (Figs. 260, 261).

113. *Verticillium candidulum.* Sacc.

Forming effused, loose, white tufts.

Sterile hyphæ creeping, septate, branched, 3–3½ μ broad.

Fertile hyphæ ascending, verticillately branched and branchlets usually 3 in a whorl, and tapering.

Conidia colourless, elliptic-oblong, inequilateral, 6½–7½ × 3–3½ μ.

On root and bark of apricot tree. Ardmona, Victoria.

It occurred as a delicate white floccose growth on the trunk close to the ground, and also on the root, where it was associated with *Coniosporium radicicolum* and *Cylindrium intermixtum* (Figs. 262, 263, 264).

114. *Coniosporium radicicolum.* N. sp.

Forming a broadly linear pulverulent stratum.

Hyphæ intermixed, colourless, short, septate, branched, and branching at right angles or dichotomously, variable in breadth up to 7½ μ.

Conidia botryoid, terminal, generally borne at the end of short branches, globose to sub-globose or irregular, brown, smooth, thick-walled, average 15-19 μ diam.

On apricot roots between bark and wood. November, 1900. Ardmona, Victoria.

Coniosporium atrum is a species described by Schweinitz, found in the interior of the stem of the cherry, but the description is too brief to allow of certain determination.

There is every indication of this species being parasitic, as it was found on living tissue both on the bark, and between the bark and the wood.

The conidia are borne in large irregular clusters like a bunch of grapes, and occasionally they are prolonged into an elongated similarly coloured stalk which may attain a length of 11 μ (Figs. 265, 266, 267).

115. *Phoma radicicola.* N. sp.

Perithecia in clusters or solitary, black, punctiform, globose, erumpent; dark-brown by transmitted light, membranaceous, firm, 250 μ diam. Sporules very numerous, hyaline, elongated elliptic, rounded at both ends, 4½–5½ × 2–2½ μ.

On dead roots of peach. April, 1901. Ardmona.

Several branches of the tree, only seven years old, had died out the previous year, and on examination the cause was found to be the attacks of the root-borer *(Leptops hopei)*, though possibly this and other fungi found on the roots hastened their death. The rootlet on which this species was found plentifully had not been attacked by the borer (Figs. 268, 269).

116. *Pyrenochæta radicina.* N. sp.

Perithecia numerous, scattered, globose, black, erumpent, membranaceous, with brown divergent spines surrounding mouth and springing from other parts of the perithecium as well, 200–230 μ diam.

Sporules hyaline to grey, homogeneous, elliptical, 6–6½ × 3 μ.

On roots of cherry. October, 1901. Shepparton (Pescott).

This was a young cherry tree only three years old, and last season it assumed an unhealthy appearance and gradually died this spring. The soil is well drained and in good condition, and other cherry trees alongside are at present quite healthy. The only evident cause of death was the fungus found plentifully on the roots. (Figs. 274, 275.)

117. *Armillaria mellea.* Vahl.

Pileus 2–5 inches across, disc fleshy, remainder thin, convex, then expanded, often becoming more or less depressed at the centre, usually ochraceous with a tinge of honey-colour, clothed with small, spreading, blackish-brown scales, margin striate. Gills adnate, then becoming more or less decurrent, somewhat distant, white with a flesh tinge, then brownish and mealy with the profuse white spores.

Stem 3–5 inches long, 3–6 lines thick, rigid, more or less grooved, dingy ochraceous, floccose or almost naked below the ring, base often covered with yellowish down, spongy, stuffed, then hollow, elastic.

Spores elliptical, 8–9 × 5–6 μ.

On roots of apricot. Shepparton, Victoria.

This fungus may either be found growing solitary near the roots of trees as a saprophyte or in dense clusters round and upon the roots of trees and bushes which it has killed. It is the cause of root-rot, and is very destructive in its effects. There is a serious disease of the apple tree here, locally known as "die-back," which is caused by it, and the characteristic black, cord-like mycelial strands cover the roots and the collar of the stem, like a dense felt or network. Delicate threads pass from these into the roots at irregular intervals and form thin white sheets of mycelium between the bark and the wood.

NATURE, HABITAT, AND DISTRIBUTION OF FUNGI.

Name of Fungus.	Page	Parasite or Saprophyte.	Habitat.	Distribution.
Acanthostigma curvisetum	123	S.	Apricot - bark ...	V.
Alternaria pruni ...	102	S.	Apricot—leaf	V.
Alternaria tenuis ...	102	S.	Plum—leaf	V.
Armillaria mellea ...	127	P.	Apricot—root	V.
Ascochyta chlorospora ...	44, 97	P.	Almond—leaf	
			Apricot—leaf and fruit ...	
			Peach - leaf and fruit ...	
			Plum—leaf	V., S.A.
Ascochyta crystallina ...	98	S.	Almond—leaf	V.
Ascochyta ovalispora ...	104	S.	Cherry—leaf and twig ...	
			Plum—leaf	V.
Aspergillus candidus ...	106	S.	Peach—leaf	V.
Aspergillus glaucus ...	86	P.	Apricot—fruit ...	V.
Bacteriosis	110	P.	Almond—leaf	
			Apricot—leaf	
			Cherry—fruit	
			Plum—leaf	V.
Botryodiplodia pruni ...	115	P.	Apricot—twig ..	
			Plum—twig	V.
Botryosphaeria pruni ...	119	S.	Apricot—twig ...	
			Plum—twig	V.
Brachysporium excorians	122	S.	Peach—branch ...	V.
Camarosporium prunifolium	109	P.	Apricot—leaf	V.
Capnodium armeniacae ...	108	P.	Apricot—leaf	V.
Cephalosporium fructigenum	85	S.	Nectarine—unripe fruit	S.A.
Cercospora circumscissa...	36, 107	P.	Peach—leaf	Q.
Cladosporium carpophilum	49, 87	P.	Peach—fruit	N.S.W.
Cladosporium condyloneina	100	P.	Almond—leaf	
			Apricot—leaf and calyx of flower	
			Peach—leaf	
			Plum—leaf	V.
Cladosporium herbarum ...	99	S.	Plum—leaf	
			Cherry—fruit	V.
Cladosporium phyllophilum	100	S.	Apricot—leaf	
			Peach—leaf and twig ...	V.
Cladosporium prunicolum	100	S.	Apricot—leaf	V.
Clasterosporium carpophilum	39, 87	P. and S.	Almond—leaf and shoot	
			Apricot—leaf, shoot, and fruit	
			Peach—leaf, shoot, and fruit	
			Plum—leaf	V., S.A., N.Z.
Coniosporium radicicolum	126	P.	Apricot—root	V.
Coniothecium albocinctum	122	P.	Peach—shoot	
			Plum—shoot	V.
Coniothecium cerasi ...	117	P.	Cherry—shoot ...	V.
Coniothecium olivaceum	117	S.	Peach—shoot	S.A.
Coniothyrium pruni ...	84	S.	Apricot—leaf and fruit	
			Plum—leaf	V.
Cornularia piriformis ...	122	S.	Peach—branch ...	V.
Cylindrium intermixtum	125	S.	Apricot—root and base of stem	V.
Cyphella marginata ...	120	S.	Peach—twig	V.
Cytospora leucostoma ...	115	S.	Almond—twig ...	
			Peach—twig	
			Plum—twig	
			Cherry-plum—twig ...	V.
Cytosporella armeniacae...	115	S.	Apricot—twig... ...	V.

Nature, Habitat, and Distribution of Fungi—*continued.*

Name of Fungus.	Page.	Parasite or Saprophyte.	Habitat.	Distribution.
Darluca filum	98	P.	Peach—leaf, branch, and fruit	
			Plum—leaf	
			Kelsey plum—leaf	V., N Z.
Dematium pullulans	45, 86, 107, 162	P.	Almond—seed and leaf	V.
			Apricot—leaf, calyx, and fruit	V. V.
			Cherry—leaf and fruit	
			Peach—leaf and fruit	V., S.A.
			Plum—leaf	V., Q.
Dendrophoma pulvis-pyrius	114	S.	Almond—twig	
			Apricot—twig	
			Peach—twig	
			Plum—twig	V., S.A.
Dictyosporium elegans	123	S.	Peach—branch	V.
Didymella fusispora	124	S.	Apricot—bark	V.
Didymochaeta australiana	98	S.	Almond—leaf	V.
Didymosphaeria cerasorum	124	S.	Apricot—bark	V.
Diplodia malorum	114	S.	Cherry-plum—twig	
			Peach—twig	
			Plum—twig	V.
Diplodia microsporella	121	S.	Peach—twig and leaf	V.
Dothiorella amygdali	114	S.	Almond—twig	
			Peach—twig	V., N.Z.
Dothiorella microspora	115	S.	Apricot—twig	V.
Epicoccum fructigenum	89	S.	Cherry—fruit	V.
Epicoccum granulatum	108	S.	Apricot—leaf	
			Peach—leaf	
			Plum—leaf	Q.
Exoascus deformans	13, 95	P.	Peach and nectarine—leaf and twig	V.
Fusarium prunorum	91	S.	Apricot—fruit	V.
Fusarium putaminum	91	S.	Apricot—fruit	V.
Fusarium roseum	118	S.	Apricot—branch and leaf	
			Plum—branch	V.
Fusarium sarcochroum	108	S.	Apricot—leaf	V.
Fusicoccum microspermum	121	S.	Apricot—branch	
			Plum—branch	V.
Gibberella pulicaris	113	S.	Apricot—twig	V
Glutinium lævatum	119	P.	Peach—twig	V.
Gnomonia circumscissa	44, 94	P.	Almond—leaf	
			Apricot—leaf	
			Cherry—leaf	
			Peach—leaf	
			Plum—leaf	
			Kelsey-plum—leaf	V.
Haplosporella pruni	114	P.	Apricot—branch	
			Plum—branch	V.
Hendersonia persicæ	121	S.	Peach—twig	V.
Hormiscium undulatum	106	S.	Apricot—leaf	S.A.
Hypholoma fasiculare	125	P.	Cherry—root	V.
Kellermannia pruni	104	S.	Almond—leaf	
			Apricot—twig	
			Plum—leaf	V.
Langloisula rubigo-spora	106	S.	Peach—leaf	V., N.Z.
Leptosphaeria vagabunda	120	S.	Peach—stem and branch	V.
Leptosphaerulina australis	103	S.	Apricot—leaf	Q., V.
Macrosporium commune	117	S.	Almond—leaf	
			Apricot—leaf	
			Plum—twig	V.
Macrosporium epicarpium	88	P.	Nectarine—fruit	S.A.
Macrosporium parasiticum	101	S.	Almond—leaf	V.
Macrosporium persicinum	117	P.	Peach—twig	V.
Macrosporium prunicolum	109	S.	Apricot—leaf	
			Plum—leaf	V.

Nature, Habitat, and Distribution of Fungi—*continued.*

Name of Fungus.	Page.	Parasite or Saprophyte.	Habitat.	Distribution.
Macrosporium uredinis	118	P.	Peach—stem	V.
Monilia fructigena	53, 85	P.	Apricot—fruit	
			Cherry—fruit	
			Peach—fruit	V., S.A.
Monilia laxa	85	S.	Apricot—fruit	V.
Monilia olivacea	105	S.	Peach—leaf	V.
Oospora roseo-basis	116	S.	Peach—shoot	V.
Ovularia cerasi	91	P.	Cherry—fruit	V.
Penicillium glaucum	86	S.	Peach—leaves, twigs, and fruit	
			Plum—leaves	V., Q.
Penicillium roseum	109	S.	Plum—leaf and fruit	V.
Pestalozzia guepini	116	S.	Almond—leaf and twig	V.
			Peach—leaf	
Phoma persicæ	124	P.	Peach—twigs	V.
Phoma radicicola	126	S.	Peach—root	V.
Phyllosticta chlorospora	108	P.	Plum—leaf	V.
Phyllosticta macrospora	108	P.	Apricot—leaf	
			Plum—leaf	
			Cherry-plum—leaf	V.
Phyllosticta matthiolana (P. perforans, Sacc.)	103	P.	Almond—leaf	
			Apricot—leaf	
			Cherry—leaf	
			Peach—leaf	
			Plum—leaf	V.
Phyllosticta persicae	43, 96	P.	Apricot—leaf	
			Peach—leaf	
			Plum—leaf	V., S.A.
Phyllosticta prunicola	41, 89	P.	Almond—leaf and fruit	
			Apricot—leaf, shoot, and fruit	
			Cherry—leaf	
			Peach—leaf, shoot, and fruit	
			Plum—leaf and shoot	
			Cherry-plum—leaf	V., S.A., Q.
Phyllosticta vulgaris var. cerasi	84	P.	Cherry—leaf and fruit	V.
Physarum calidris	96	S.	Plum—leaf	V.
Pleospora armeniacae	113	S.	Apricot—twig	V.
Pleospora aurea	94	S.	Apricot—leaf	V.
Pleospora herbarum	95	S.	Apricot—leaf	
			Plum—leaf	V.
Pleospora permunda	95	S.	Apricot—leaf	V.
Pleospora vulgaris	102	S.	Cherry—leaf	V.
Polyporus lentus	112	P. and S.	Apricot—stem	V.
Polystictus cinnabarinus	57, 112	P.	Apricot—stem and branch	
			Cherry—stem and branch	V.
Puccinia pruni	23, 93	P.	Almond—leaf and fruit	
			Apricot—leaf and fruit	
			Nectarine—leaf	
			Peach—stem, leaf, and fruit	
			Plum—leaf	V., N.S.W., Q., S.A., T.
Pyrenochaeta radicina	127	P.	Cherry—root	V.
Pyrenochaeta rosella	97	S.	Almond—leaf	
			Apricot—leaf and fruit	
			Peach—leaf	V.
Rebentischia massalongi	123	S.	Apricot—bark	V.
Rhabdospora corticola	122	S.	Apricot—branch	V.
			Peach—branch	V.
Rhizopus apiculatus	96	S.	Apricot—leaf	
			Plum—leaf	V.

NATURE, HABITAT, AND DISTRIBUTION OF FUNGI—*continued.*

Name of Fungus.	Page.	Parasite or Saprophyte.	Habitat.	Distribution.
Rhizopus nigricans ...	89	S.	Apricot—fruit... ... Plum—fruit	 V.
Rhizopus schizans ...	72, 84	P.	Peach—fruit	V.
Rosellinia aurea ...	102	S.	Plum—leaf	V.
Schizophyllum commune	112	S.	Apricot—stem and branch	V.
Schizoxylon lividum ...	120	S.	Peach—twig	V.
Septocylindrium bonordenii	99	S.	Apricot—leaf	V.
Septoria effusa	99	P.	Almond—leaf	V.
Sphaeropsis cerasifolia ...	104	S.	Cherry—leaf	V.
Sphaerulina pruni ...	113	S.	Almond—twig ...	V.
Sporodesmium subcuticulare	116	S.	Apricot—twig ...	V.
Trichoderma racemosum ...	105	S.	Peach—leaf	V.
Trichothecium roseum ...	86	S.	Almond—leaf and fruit... Apricot—leaf and fruit ... Peach—leaf and fruit ...	 V.
Tubercularia olivacea ...	109	S.	Apricot—leaf	V.
Vermicularia angustispora	104	S.	Plum—leaf	V.
Verticillium candidulum	126	S.	Apricot—root and base of stem	V.
Verticillium lateritium ...	85	S.	Almond—leaf ... ... Peach—fruit ... ... Plum—fruit	 V
Volutella penicillioides ...	110	S.	Plum—leaf	V.

HOST INDEX.

ALMOND.

Ascochyta chlorospora—Leaf
Ascochyta crystallina—Leaf
Bacteriosis—Leaf
Cladosporium condylonema—Leaf
Clasterosporium carpophilum—Leaf and twig
Cytospora leucostoma—Twig
Dematium pullulans—Seed and leaf
Dendrophoma pulvis-pyrius—Twig
Didymochæta australiana—Leaf
Dothiorella amygdali—Branch
Gnomonia circumscissa—Leaf
Kellermannia pruni—Leaf
Macrosporium commune—Leaf
Macrosporium parasiticum—Leaf
Pestalozzia guepini—Leaf and twig
Phyllosticta matthiolana—Leaf
Phyllosticta prunicola—Leaf and fruit
Puccinia pruni—Leaf and fruit
Pyrenochæta rosella—Leaf
Septoria effusa—Leaf
Sphærulina pruni—Twig
Trichothecium roseum—Leaf and fruit
Verticillium lateritium—Leaf.

APRICOT.

Acanthostigma curvisetum—Twig
Alternaria pruni—Leaf
Armillaria mellea—Root
Ascochyta chlorospora—Leaf and fruit
Aspergillus glaucus—Fruit
Bacteriosis—Leaf
Botryodiplodia pruni—Twig
Botryosphæria pruni—Twig
Camarosporium prunifolium—Leaf
Capnodium armeniacae—Leaf
Cladosporium condylonema—Leaf and calyx
Cladosporium phyllophilum—Leaf
Cladosporium prunicolum—Leaf
Clasterosporium carpophilum—Leaf, branch, and fruit
Coniosporium radicicolum—Root
Coniothyrium pruni—Leaf and fruit
Cylindrium intermixtum—Root and base of stem
Cytosporella armeniacae—Twig
Dematium pullulans—Leaf, calyx, and fruit
Dendrophoma pulvis-pyrius—Twig
Didymella fusispora—Twig
Didymosphaeria cerasorum—Twig
Dothiorella microspora—Twig
Epicoccum granulatum—Leaf
Fusarium prunorum—Fruit
Fusarium putaminum—Fruit
Fusarium roseum—Twig and leaf
Fusarium sarcochroum—Leaf
Fusicoccum microspermum—Branch
Gibberella pulicaris—Branch
Gnomonia circumscissa—Leaf
Haplosporella pruni—Twig
Hormiscium undulatum—Leaf
Kellermannia pruni—Twig
Leptosphaerulina australis—Leaf
Macrosporium commune—Leaf
Macrosporium prunicolum—Leaf
Monilia fructigena—Fruit
Monilia laxa—Fruit

Phyllosticta macrospora—Leaf
Phyllosticta matthiolana—Leaf
Phyllosticta persicæ—Leaf
Phyllosticta prunicola—Branch, leaf, and fruit
Pleospora armeniacæ—Twig
Pleospora aurea—Leaf
Pleospora herbarum—Leaf
Pleospora permunda—Leaf
Polyporus lentus—Stem and branch
Polystictus cinnabarinus—Stem and branch
Puccinia pruni—Leaf and fruit
Pyrenochaeta rosella—Leaf and fruit
Rebentischia massalongi—Branch
Rhabdospora corticola—Bark
Rhizopus apiculatus—Leaf
Rhizopus nigricans—Fruit
Schizophyllum commune—Stem and branch
Septocylindrium bonordenii—Leaf
Sporodesmium subcuticulare—Twig
Trichothecium roseum—Leaf and fruit
Tubercularia olivacea—Leaf
Verticillium candidulum—Root and base of stem.

CHERRY.

Ascochyta ovalispora—Leaf and twig
Bacteriosis—Fruit
Cladosporium herbarum—Fruit
Coniothecium cerasi—Branch
Dematium pullulans—Leaf and fruit
Epicoccum fructigenum—Fruit
Gnomonia circumscissa—Leaf
Hypholoma fasciculare—Root
Monilia fructigena—Fruit
Ovularia cerasi—Fruit
Phyllosticta vulgaris var. cerasi—Leaf and fruit
Phyllosticta matthiolana—Leaf
Phyllosticta prunicola—Leaf and fruit
Pleospora vulgaris—Leaf
Polystictus cinnabarinus—Stem and branch
Pyrenochaeta radicina—Root
Sphaeropsis cerasifolia—Leaf.

PEACH.

Ascochyta chlorospora—Leaf and fruit
Aspergillus candidus—Leaf
Brachysporium excorians—Branch
Cephalosporium fructigenum—Fruit (nectarine)
Cercospora circumscissa—Leaf
Cladosporium carpophilum—Fruit
Cladosporium condylonema—Leaf
Cladosporium phyllophilum—Leaf and twig
Clasterosporium carpophilum—Branch, leaf and fruit
Coniothecium albo-cinctum—Fruit
Coniothecium olivaceum—Twig
Cornularia piriformis—Branch
Cyphella marginata—Twig
Cytospora leucostoma—Twig
Darluca filum—Stem, leaf and fruit
Dematium pullulans—Leaf and fruit
Dendrophoma pulvis-pyrius—Twig
Dictyosporium elegans—Branch
Diplodia malorum—Twig
Diplodia microsporella—Twig and leaf
Dothiorella amygdali—Branch
Epicoccum granulatum—Leaf
Exoascus deformans—Leaf and twig (Nectarine—Leaf)
Glutinium laevatum—Twig
Gnomonia circumscissa—Leaf
Hendersonia persicae—Twig
Kellermannia pruni—Leaf
Langloisula rubigo-spora—Leaf

Leptosphaeria vagabunda—Stem and branch
Macrosporium epicarpium—Fruit (nectarine)
Macrosporium persicinum—Twig
Macrosporium uredinis—Stem
Monilia fructigena—Fruit
Monilia olivacea—Leaf
Oospora roseo-basis—Twig
Penicillium glaucum—Twig, leaf, and fruit
Pestalozzia guepini—Leaf
Phoma persicae—Twig
Phoma radicicola—Root
Phyllosticta matthiolana—Leaf
Phyllosticta persicae—Leaf
Phyllosticta prunicola—Branch, leaf, and fruit
Puccinia pruni—Stem, leaf, and fruit (Nectarine Leaf)
Pyrenochaeta rosella—Leaf
Rhabdospora corticola—Twig
Rhizopus schizans—Fruit
Schizoxylin lividum—Twig
Trichoderma racemosum—Leaf
Trichothecium roseum—Leaf and fruit
Verticillium lateritium—Fruit.

PLUM.

Alternaria tenuis—Leaf
Ascochyta chlorospora—Leaf (and Cherry Plum)
Ascochyta ovalispora—Leaf
Bacteriosis—Leaf
Botryodiplodia pruni—Twig
Botryosphæria pruni—Twig
Cladosporium condylonema—Leaf
Cladosporium herbarum—Leaf
Clasterosporium carpophilum—Leaf and fruit
Coniothecium albo-cinctum—Twig
Coniothyrium pruni—Leaf
Cytospora leucostoma—Twig (and Cherry Plum)
Darluca filum—Leaf (and Kelsey Plum)
Dematium pullulans—Leaf
Dendrophoma pulvis-pyrius—Twig
Diplodia malorum—Twig (and Cherry Plum)
Epicoccum granulatum—Leaf
Fusarium roseum—Twig
Fusicoccum microspermum—Branch
Gnomonia circumscissa—Leaf (and Japanese Plum)
Haplosporella pruni—Twig
Kellermannia pruni—Leaf
Macrosporium commune—Twig
Macrosporium prunicolum—Leaf
Penicillium glaucum—Leaf
Penicillium roseum—Leaf and fruit
Phyllosticta chlorospora—Leaf
Phyllosticta macrospora—Leaf (and Cherry Plum)
Phyllosticta matthiolana—Leaf
Phyllosticta persicae—Leaf
Phyllosticta prunicola—Leaf, twig, and fruit (and Cherry Plum Leaf)
Physarum calidris—Leaf
Pleospora herbarum—Leaf
Puccinia pruni—Leaf (and Japanese Plum)
Rhizopus apiculatus—Leaf
Rhizopus nigricans—Fruit
Rosellinia aurea—Leaf
Vermicularia angustispora—Leaf
Verticillium lateritium—Fruit
Volutella penicillioides—Leaf.

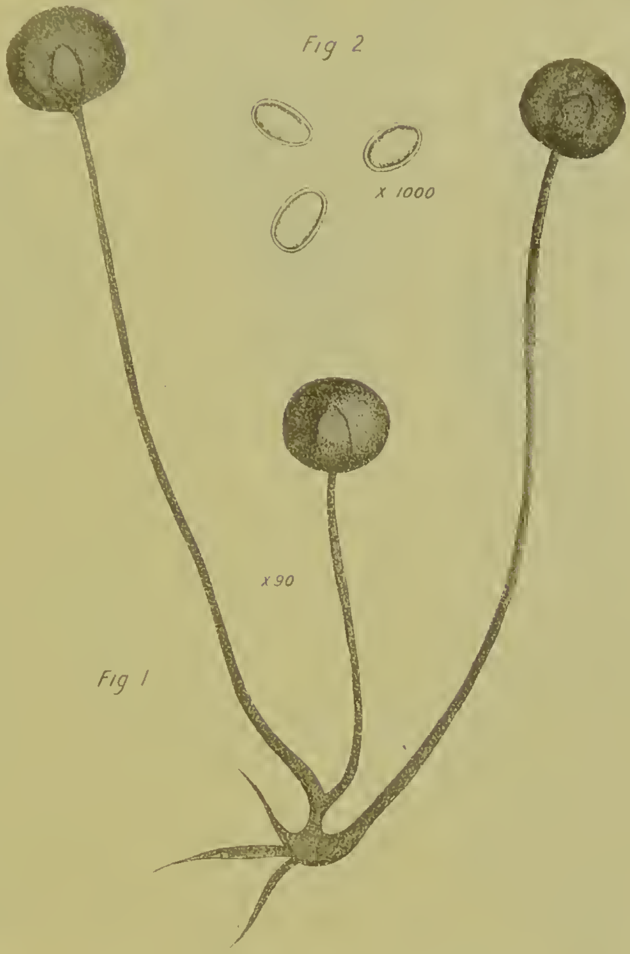

Fig 2

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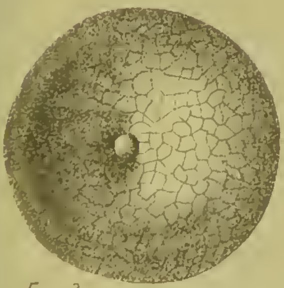
Fig 1



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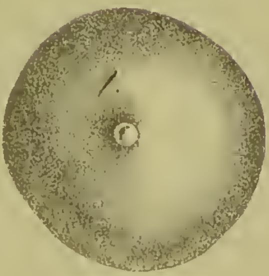

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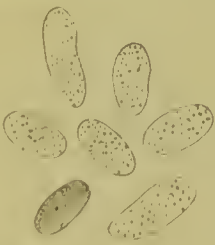

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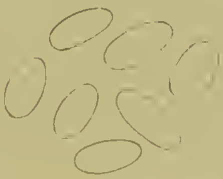
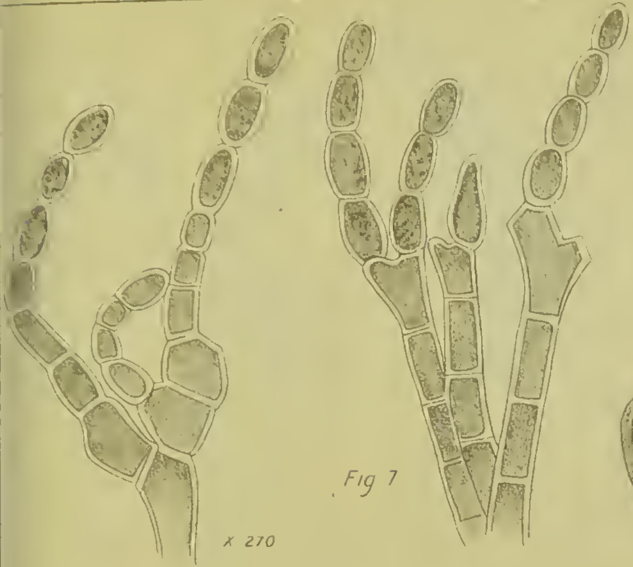


Fig. 6 x 1000

Fruit No 2

Plate XVI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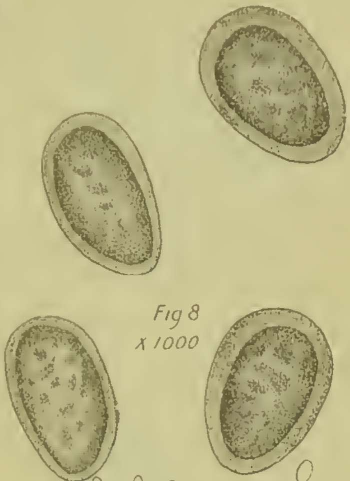
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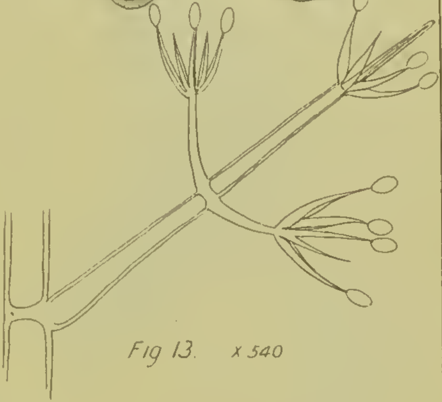
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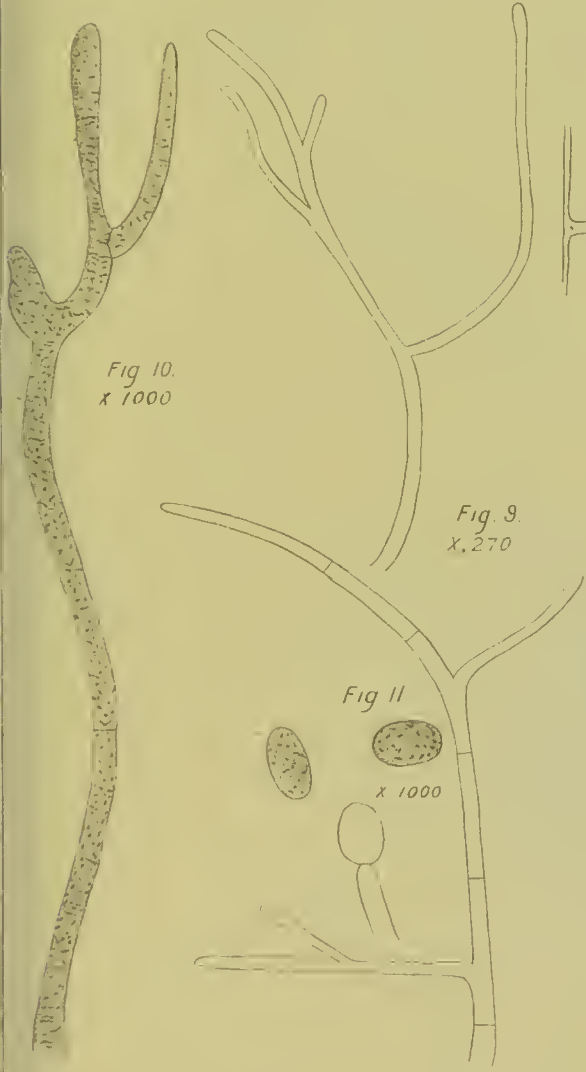
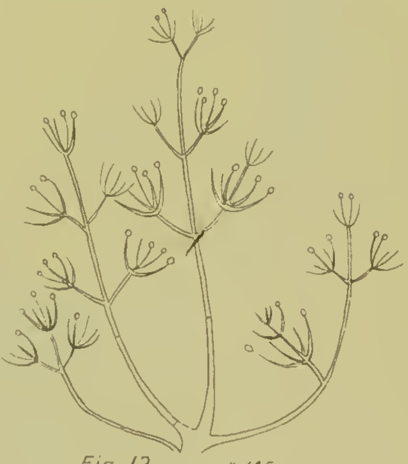


Fig 10.
x 1000

Fig. 9.
x. 270

Fig 11
x 1000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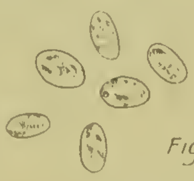
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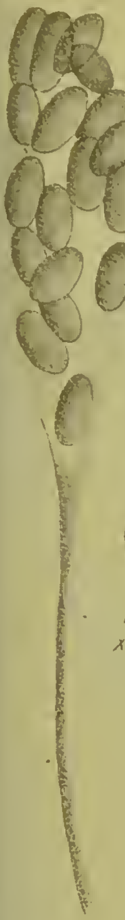

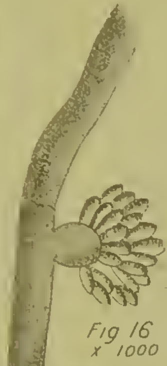

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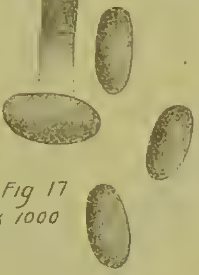

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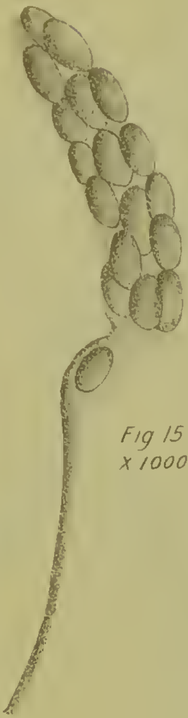

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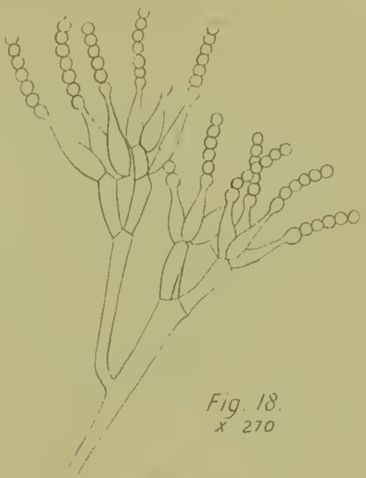

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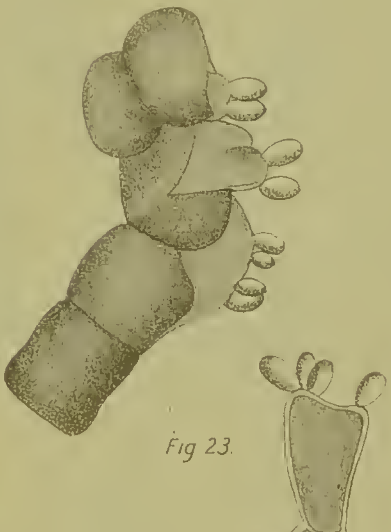


Fig 23.

x 1000

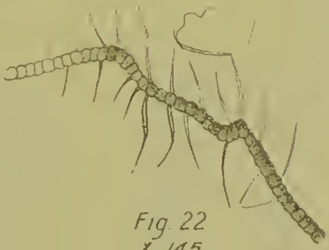


Fig. 22
x 145

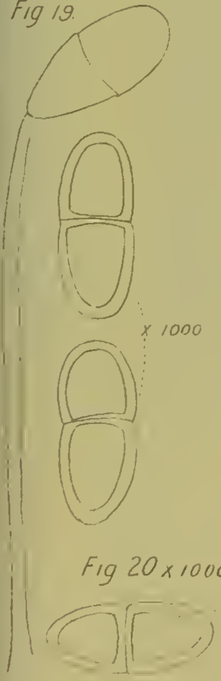
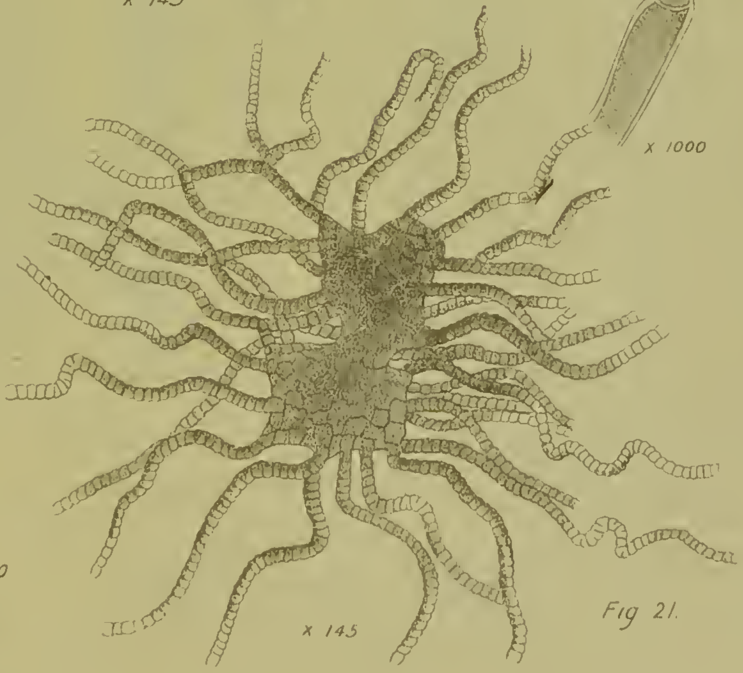


Fig 19.

x 1000

Fig 20 x 1000



x 145

Fig 21.

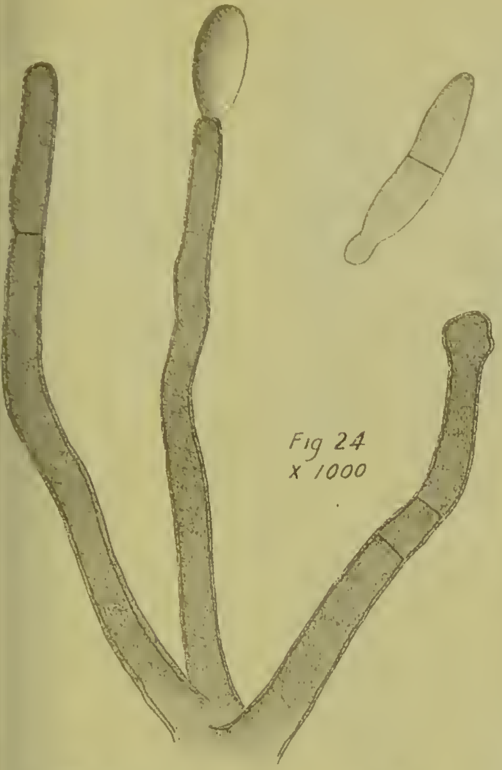


Fig 24
x 1000

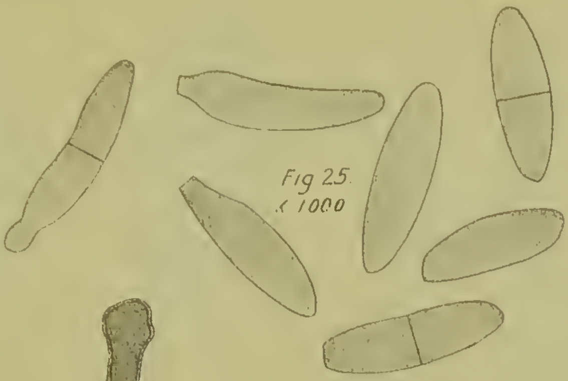


Fig 25.
x 1000

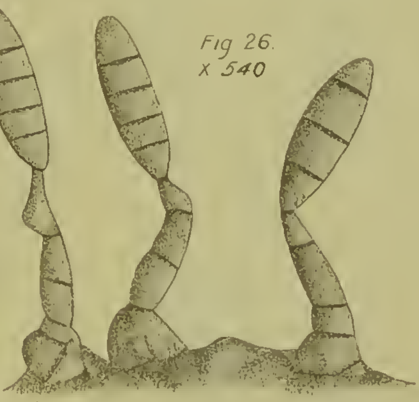


Fig 26.
x 540

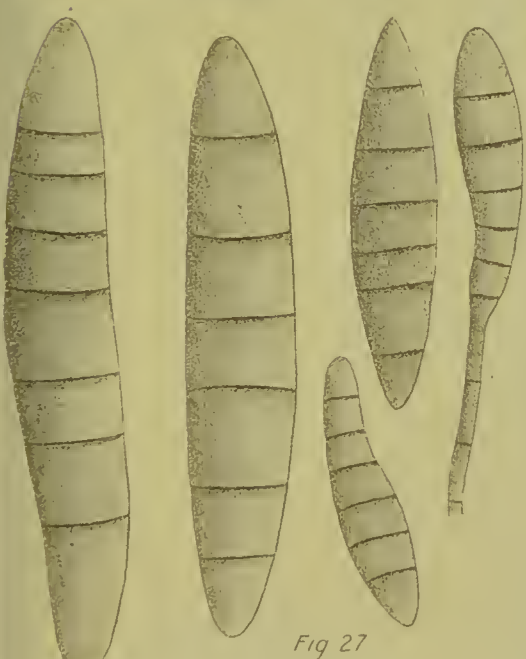


Fig 27

x 1000

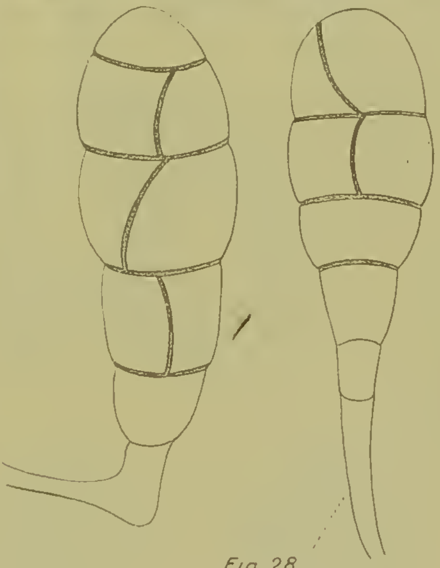
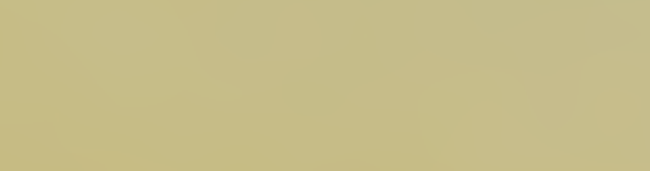


Fig. 28.
x 1000



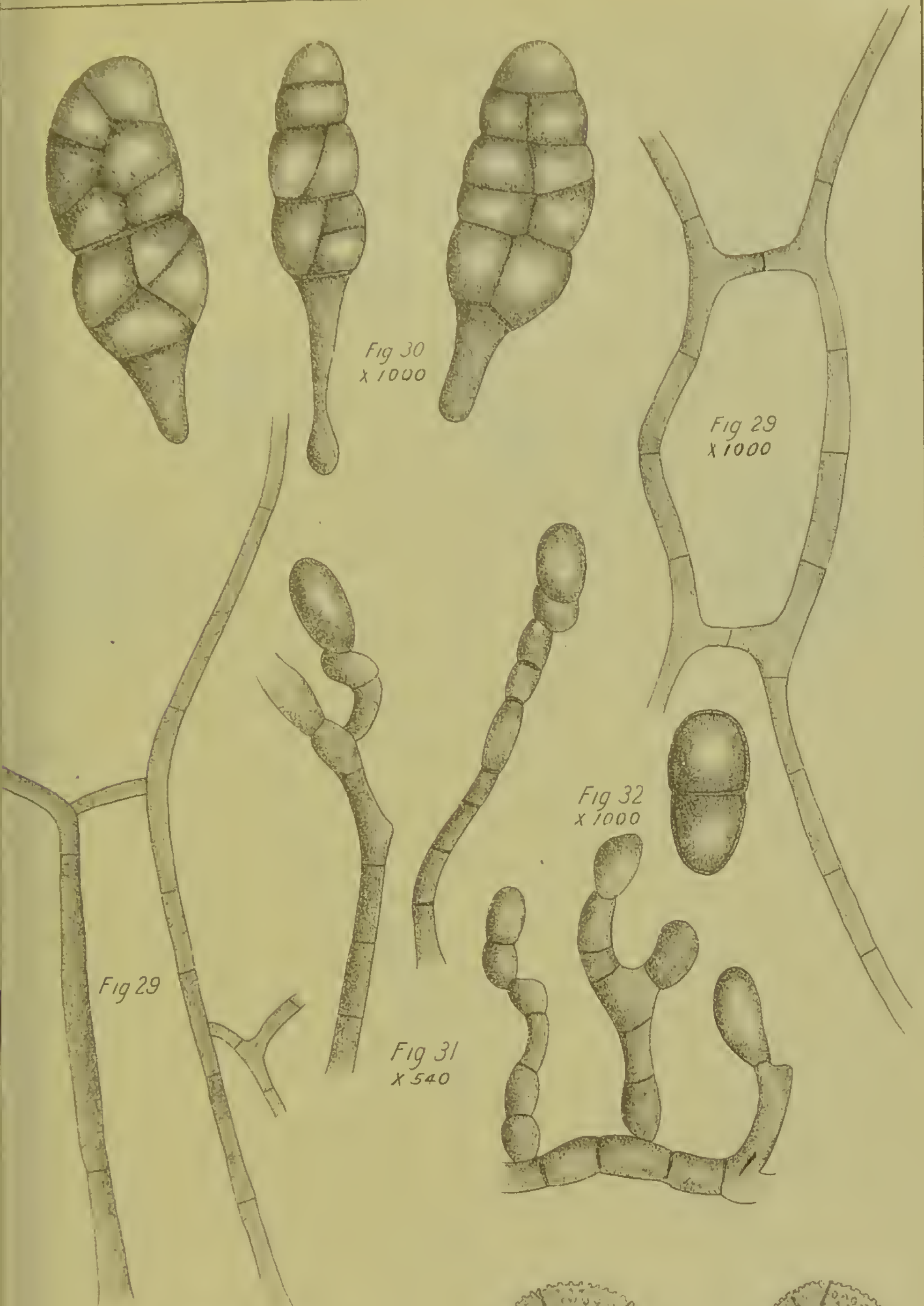


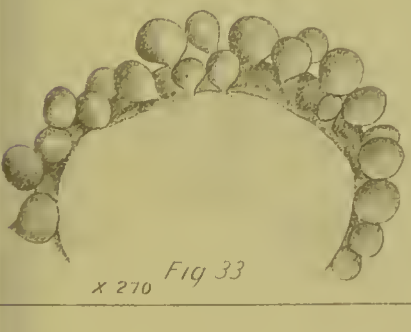
Fig 30
x 1000

Fig 29
x 1000

Fig 32
x 1000

Fig 29

Fig 31
x 540



x 270 Fig 33

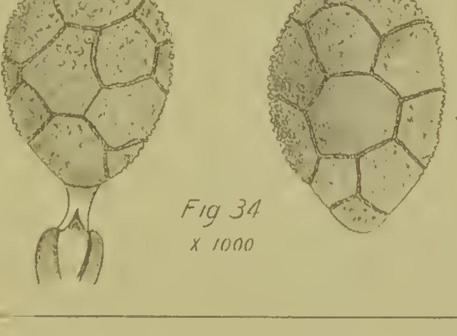


Fig 34
x 1000

Fruit No 6 Plate XX

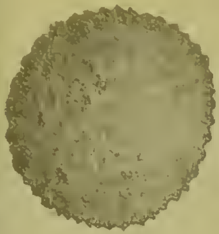


Fig 39
x 145

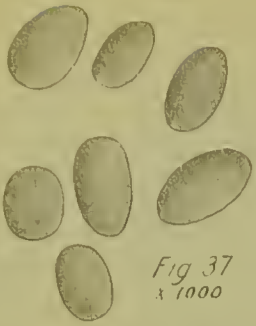


Fig 37
x 1000

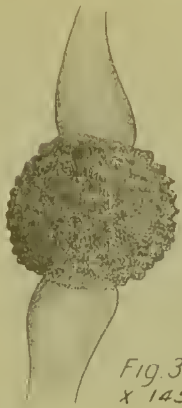
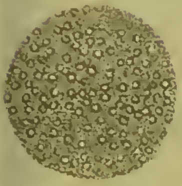


Fig.38
x 145

Fig 41
x 15



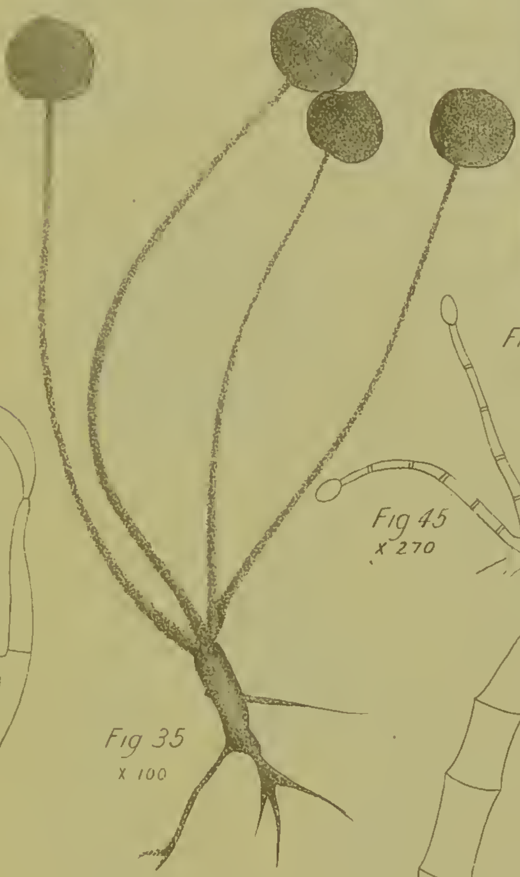


Fig 35
x 100

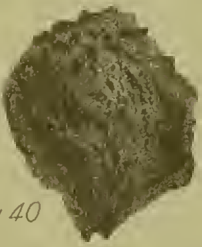


Fig 40

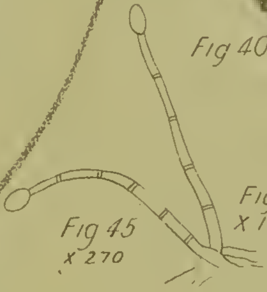


Fig 45
x 270

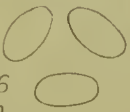


Fig 46
X 1000

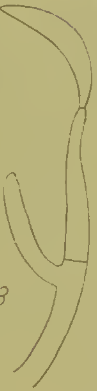


Fig 43
x 1000

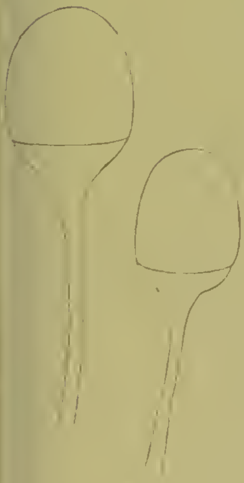


Fig 36
X 1.45

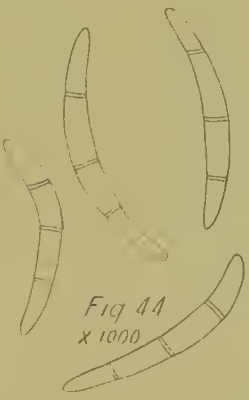


Fig 44
x 1000

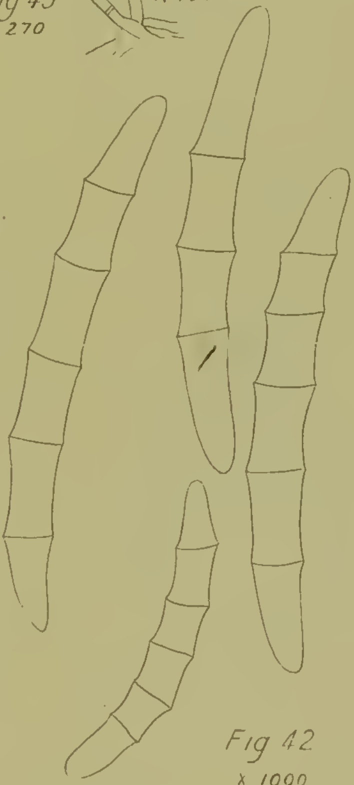


Fig 42
x 1000

Leaf N°1

Plate XXI

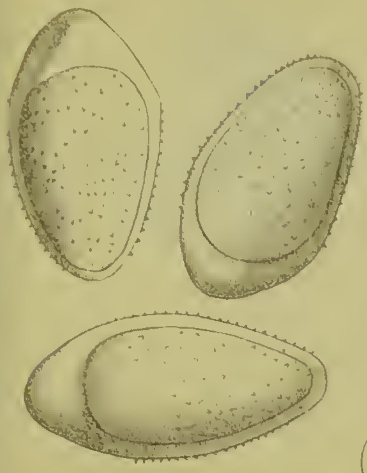


Fig 47
x 1000

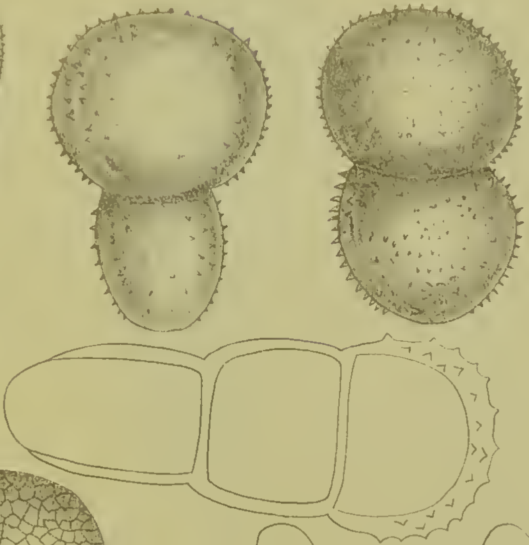


Fig 48
x 1000

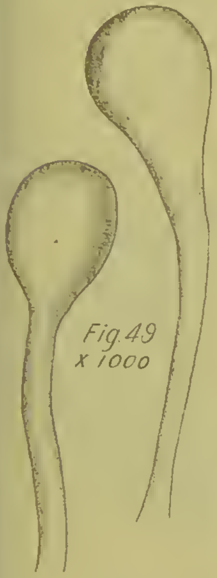


Fig. 49
x 1000

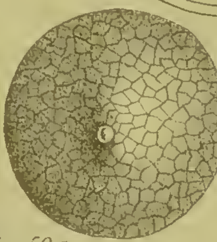


Fig 50 a
x 145

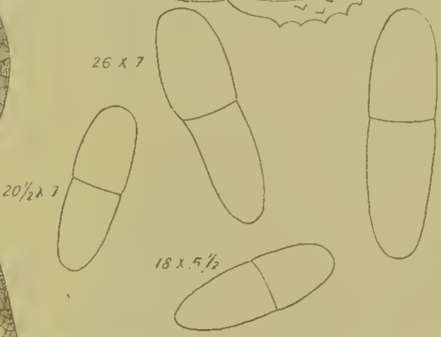


Fig. 52
x 1000

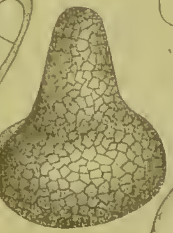


Fig 50 b
x 145

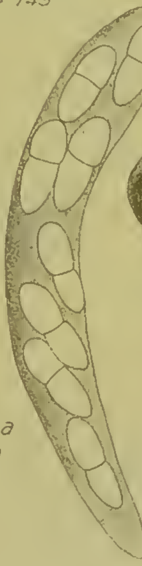


Fig 51 a
x 540

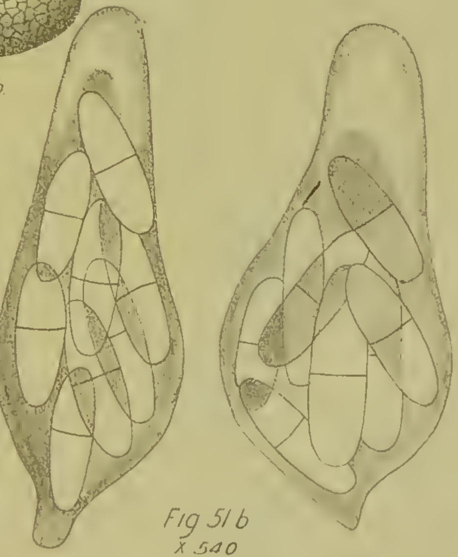


Fig 51 b
x 540

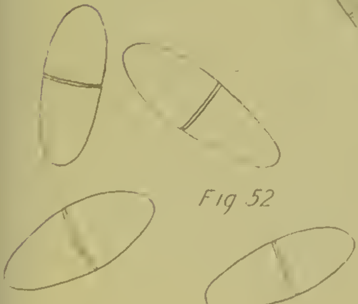


Fig 52
x 1000

Leaf No. 2

Plate XXII

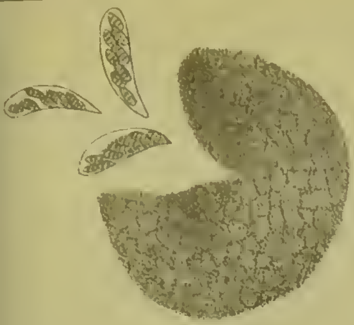


Fig 53
x 145

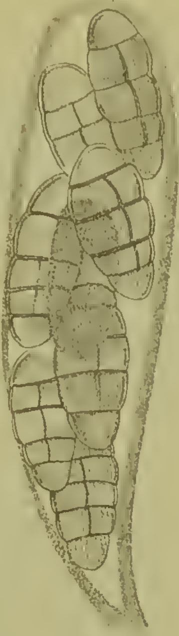


Fig. 54
x 1000

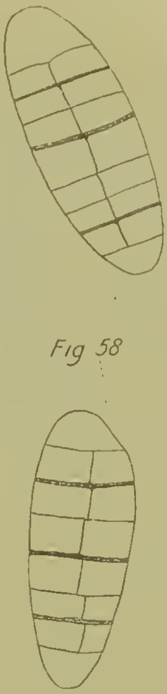


Fig 58
x 1000

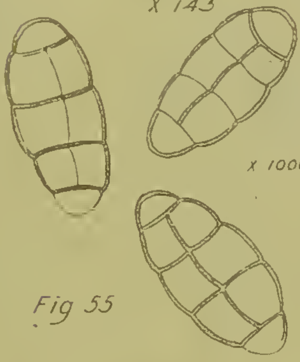


Fig 55
x 1000

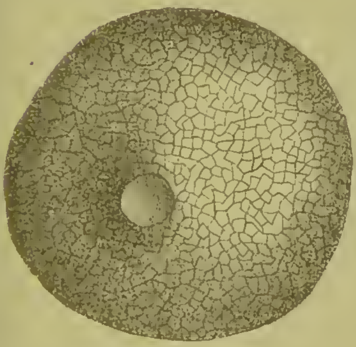


Fig 56
x 145

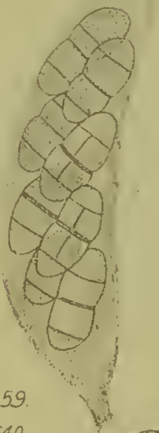


Fig 59.
x 540

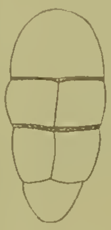


Fig 60
x 1000

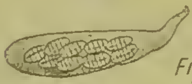


Fig 57
x 145

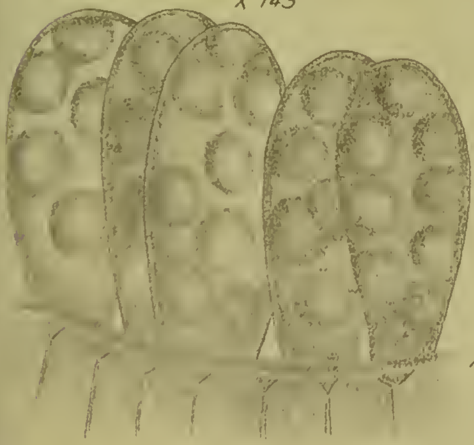


Fig 61
x 1000

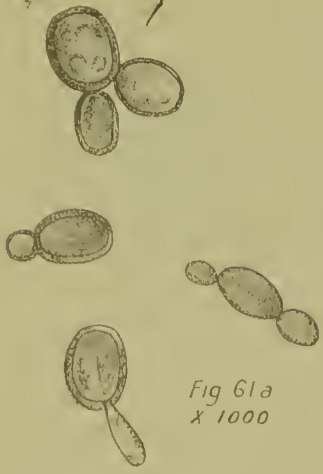


Fig 61a
x 1000

Leaf. N° 3

Plate XXIII

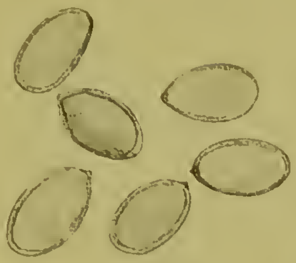


Fig. 64
x 1000

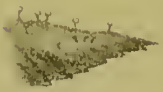


Fig. 65

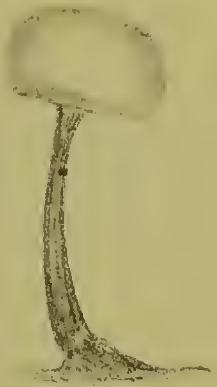


Fig. 66
x 52

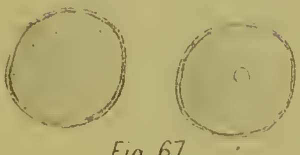


Fig. 67
x 1000

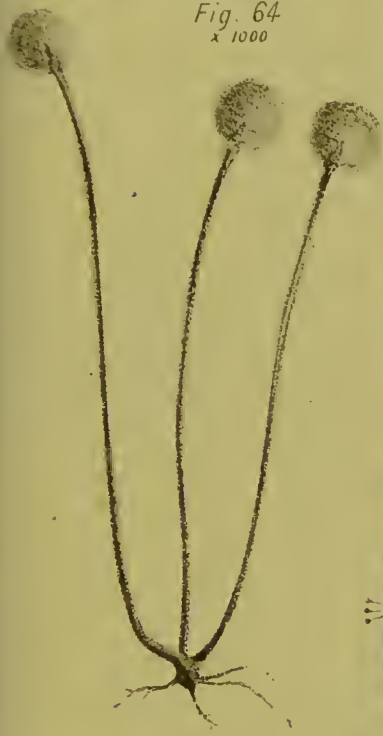


Fig. 63
x 100

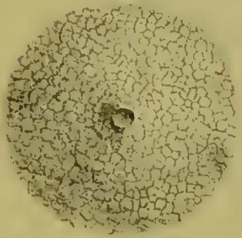


Fig. 68
x 145

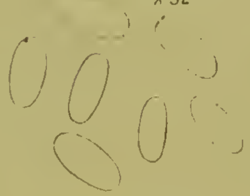


Fig. 69
x 1000

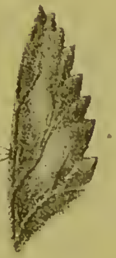


Fig. 62

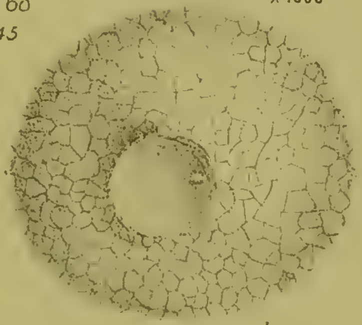


Fig. 70^{b}
x 270

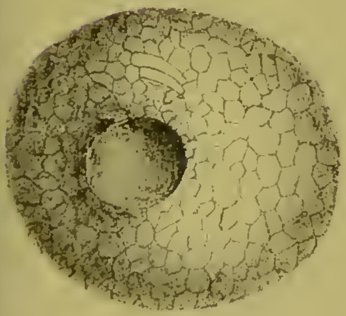


Fig. 70^{a}
x 270

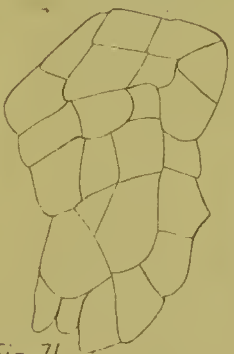


Fig. 71
x 1000

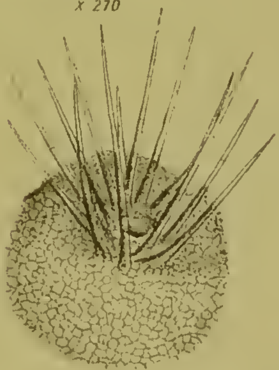


Fig. 73
x 145

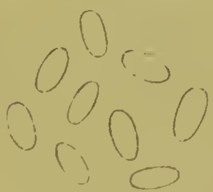


Fig. 72
x 1000

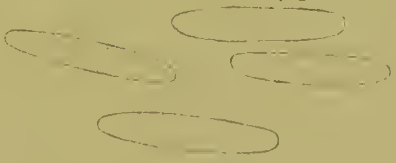


Fig 74
x 1000

Leaf No 4

Plate XXIV

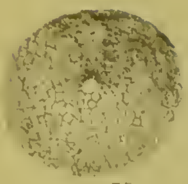


Fig. 75
x 145

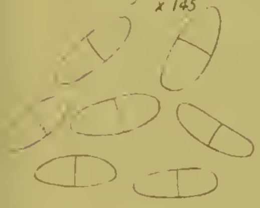


Fig. 76
x 1000

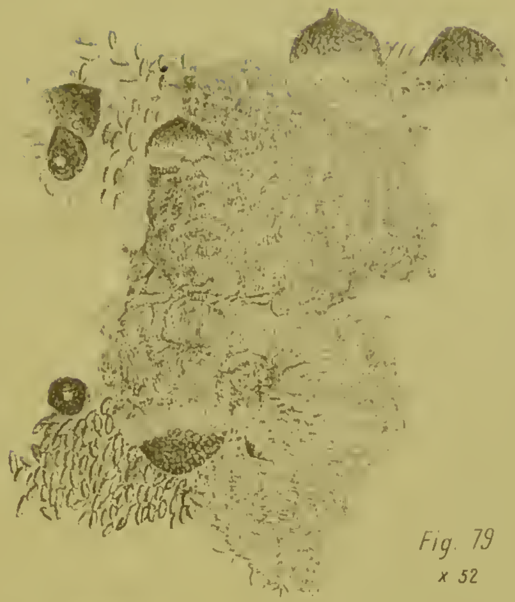


Fig. 79
x 52

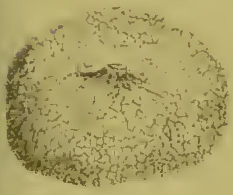


Fig. 77
x 95

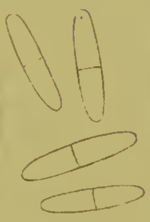


Fig. 78
x 1000

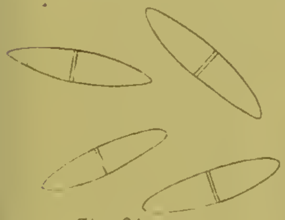


Fig. 81
x 1000

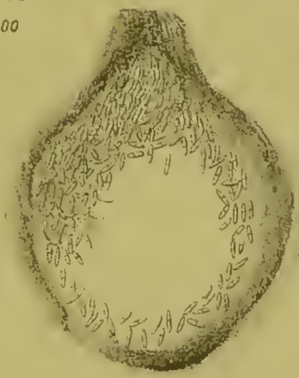


Fig. 80
x 145

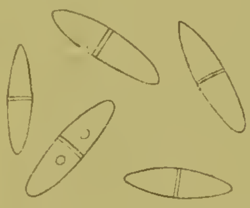


Fig. 81

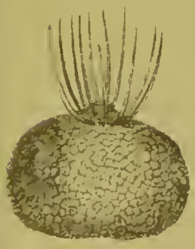


Fig. 82
x 145

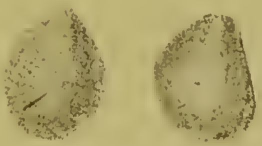


Fig. 84
x 145

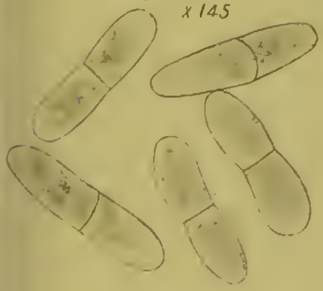


Fig 83
x 1000

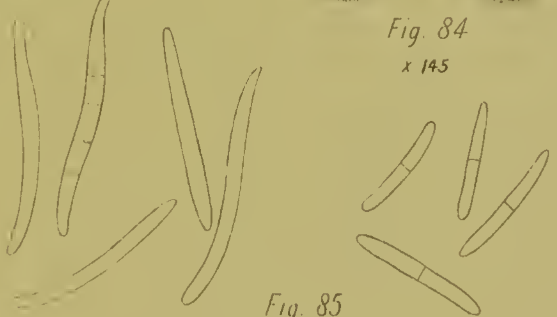


Fig. 85
x 1000

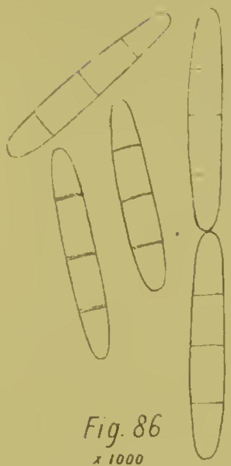


Fig. 86
x 1000

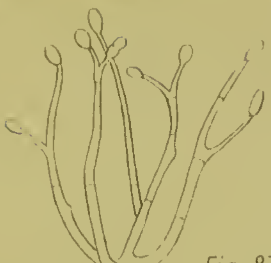


Fig. 87
x 270

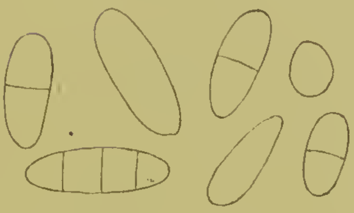


Fig. 88
x 1000

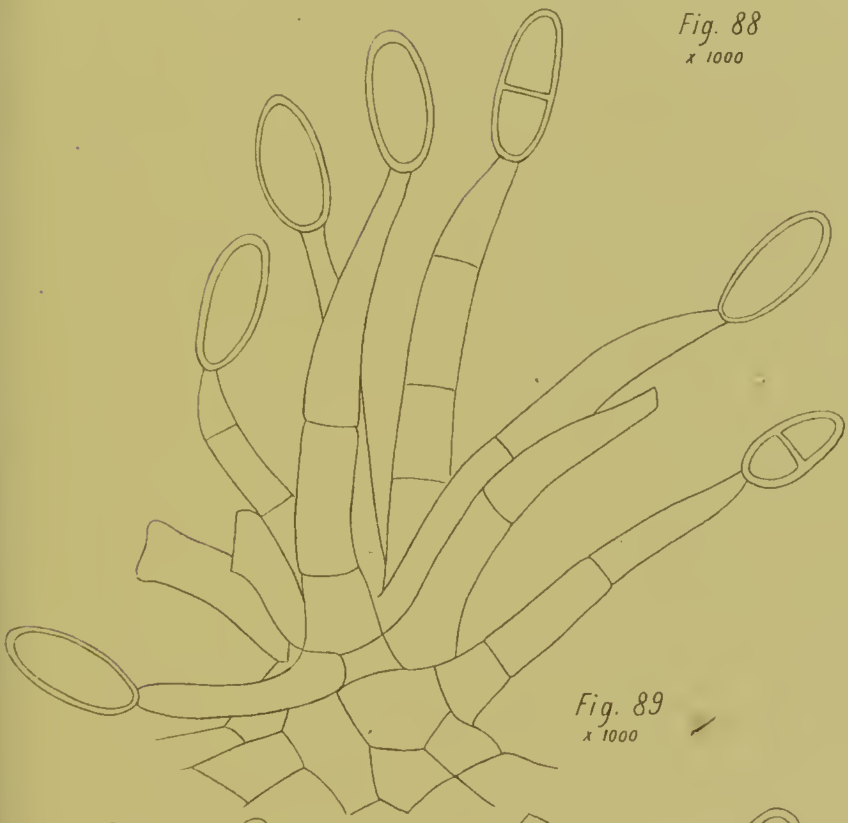


Fig. 89
x 1000

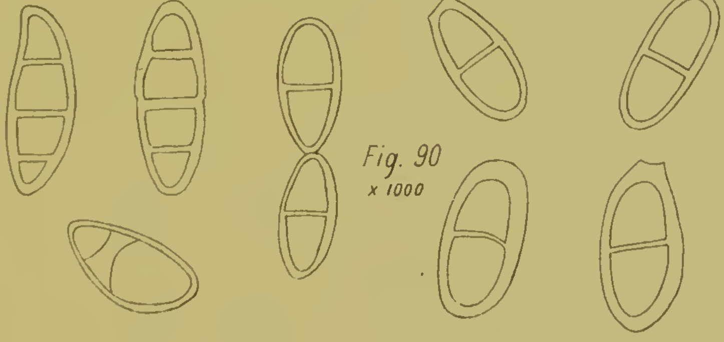


Fig. 90
x 1000

Leaf, No. 6

Plate XXVI

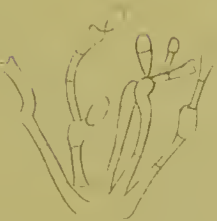


Fig. 91
x 270

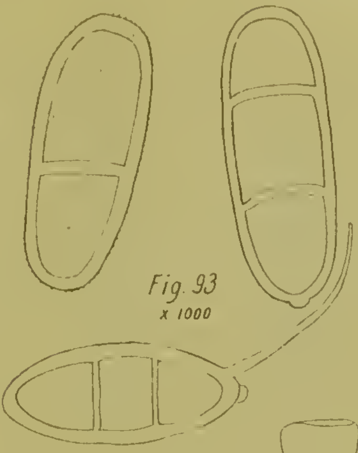


Fig. 93
x 1000

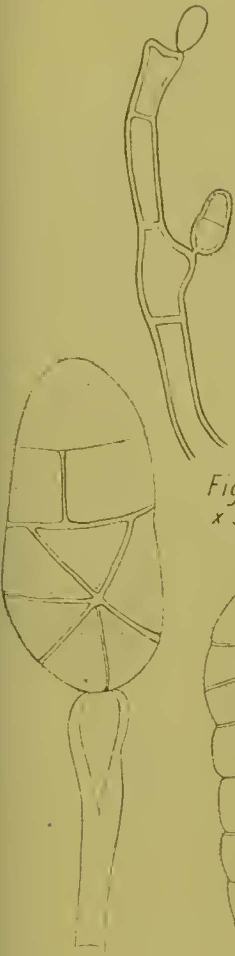


Fig. 92
x 540

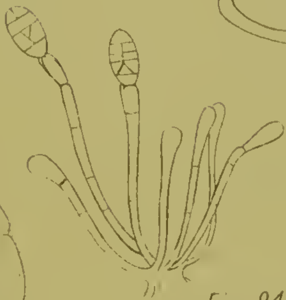


Fig. 94
x 270

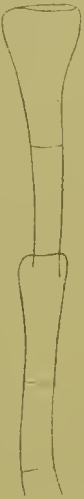
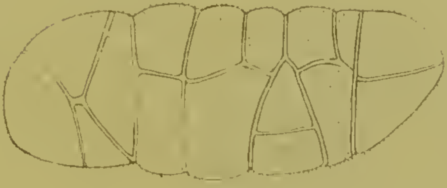


Fig. 95
x 1000



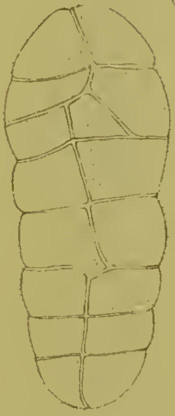


Fig. 96
x 1000

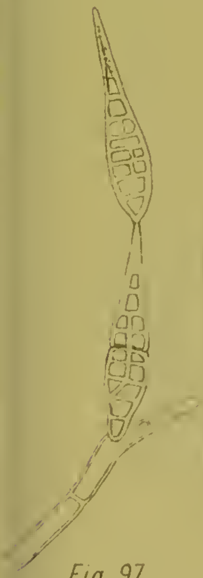


Fig. 97
x 270

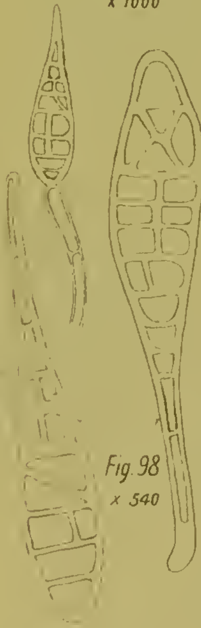


Fig. 98
x 540

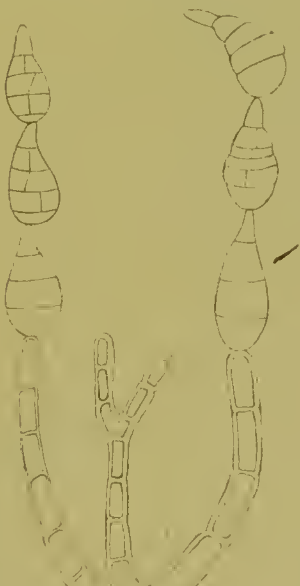


Fig. 99
x 540

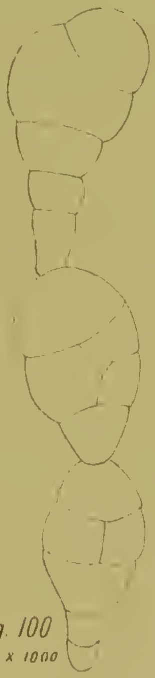


Fig. 100
x 1000

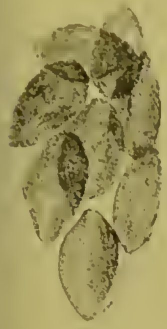


Fig. 101
x 540

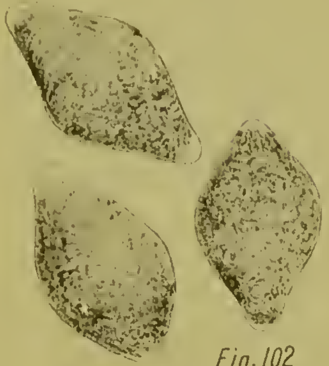


Fig. 102
x 1000

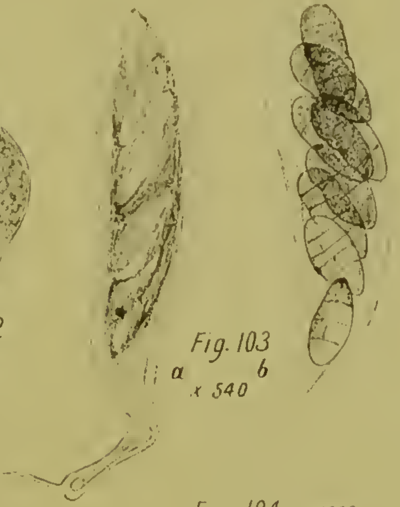


Fig. 103
a b
x 540

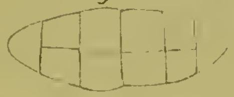


Fig 104 x 1000

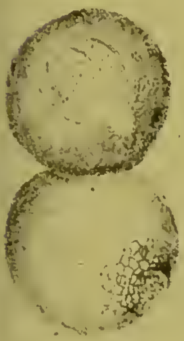


Fig. 105
x 145

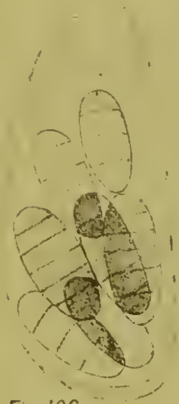


Fig. 106
x 540

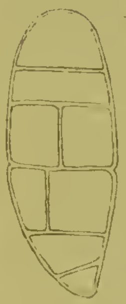


Fig. 107
x 1000

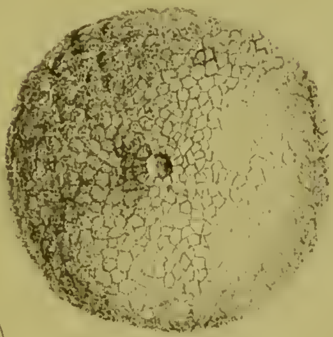


Fig. 112
x 145

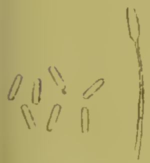


Fig. 109
x 1000

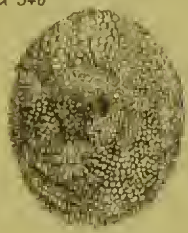


Fig. 108
x 145

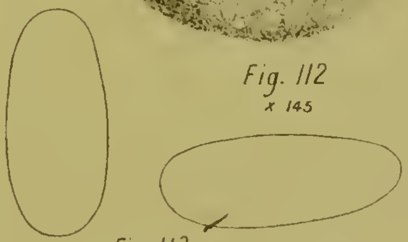


Fig. 113
x 1000

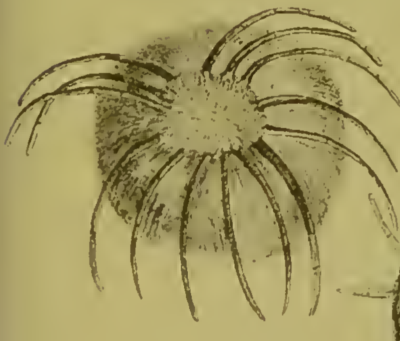


Fig. 110 a
x 145

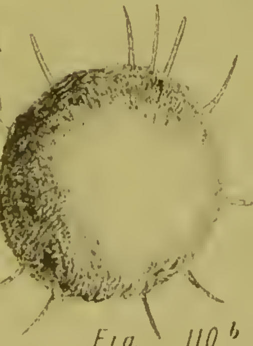


Fig. 110 b
x 145

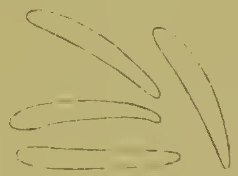


Fig. 111
x 1000

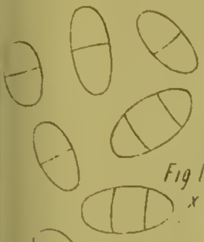


Fig 114
x 1000

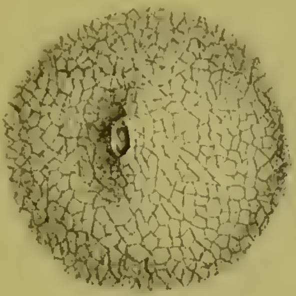


Fig. 115
x 145

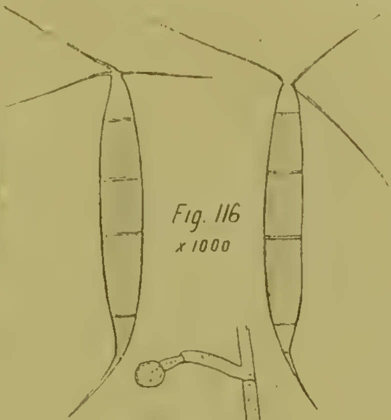


Fig. 116
x 1000

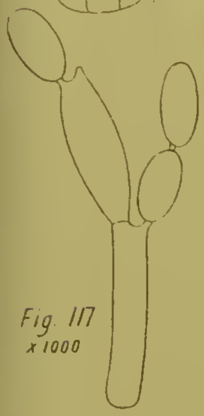


Fig. 117
x 1000

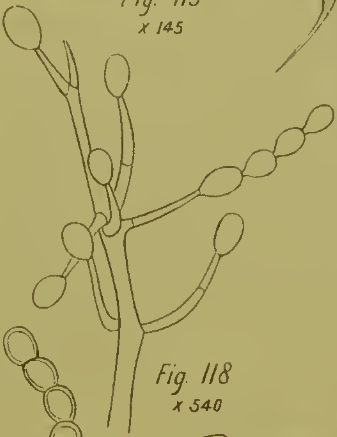


Fig. 118
x 540

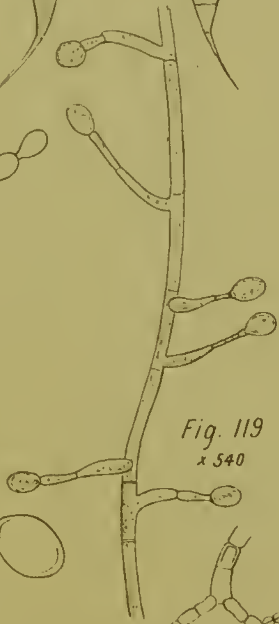


Fig. 119
x 540

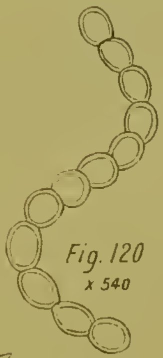


Fig. 120
x 540

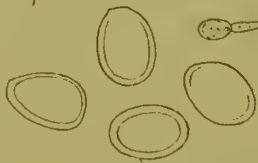


Fig. 121
x 1000

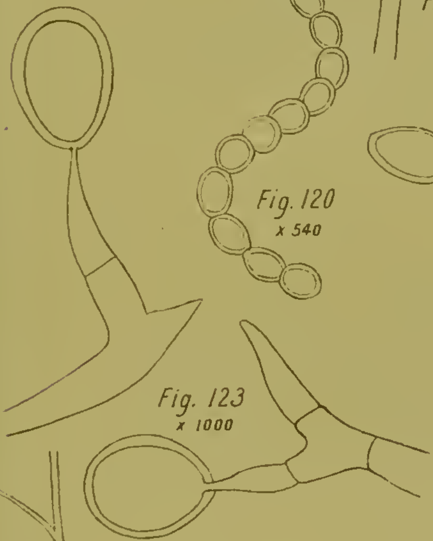


Fig. 123
x 1000

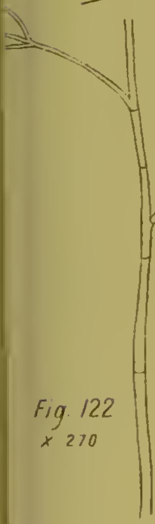


Fig. 122
x 270

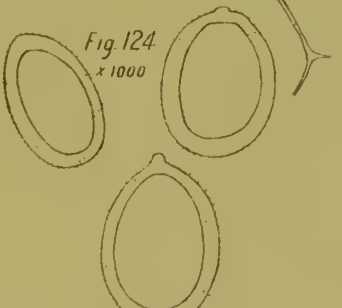


Fig. 124
x 1000

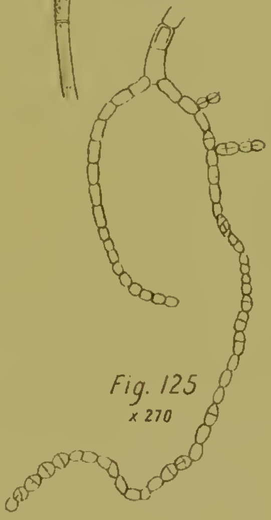


Fig. 125
x 270

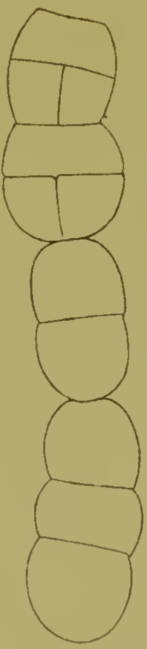
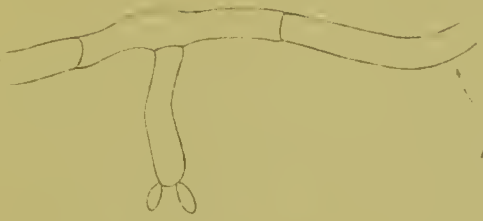


Fig. 126
x 1000

Leaf No. 9

Plate XXIX



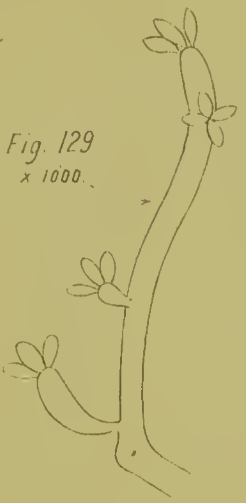


Fig. 129
x 1000.

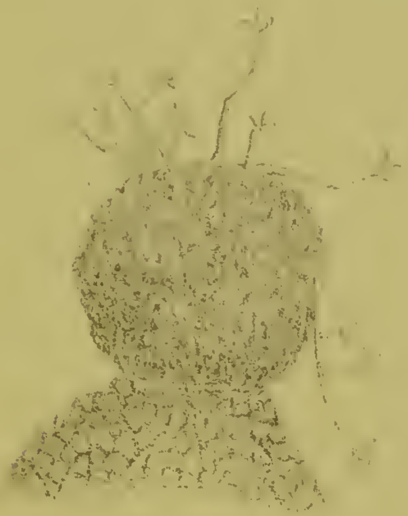


Fig. 128
x 270

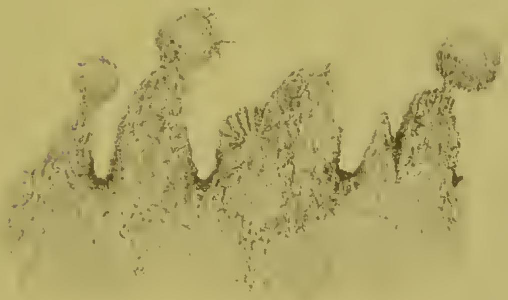


Fig. 127
x 52

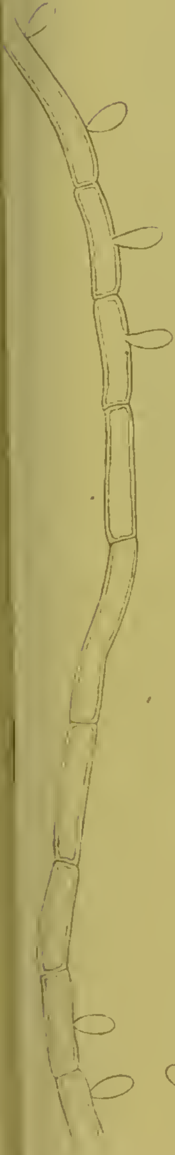


Fig 133
x 1000

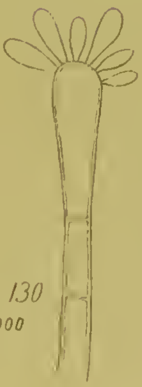


Fig 130
x 1000

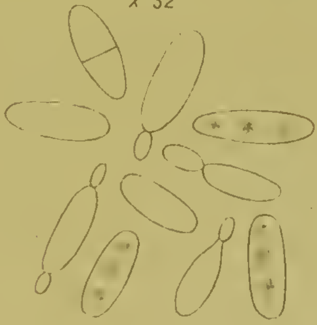


Fig 132
x 1000

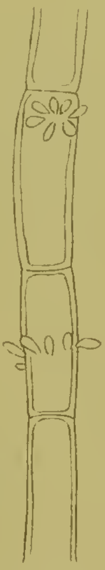


Fig. 133
x 1000

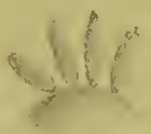


Fig 131
x 1000

eaf Nº 10

Plate XXX

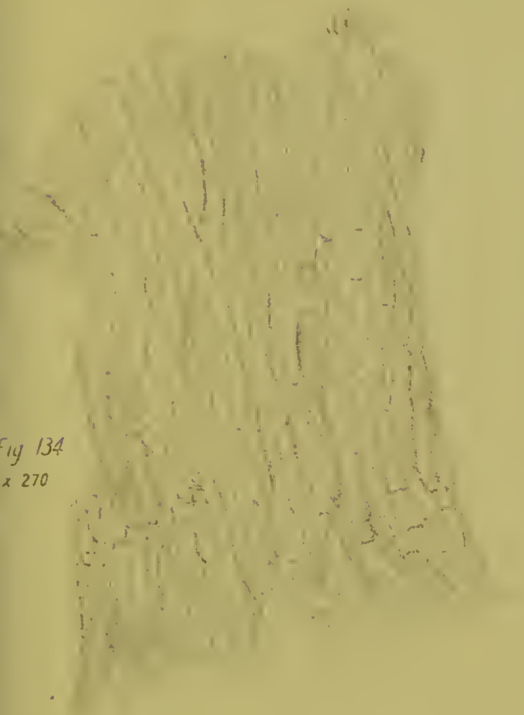


Fig 134
x 270

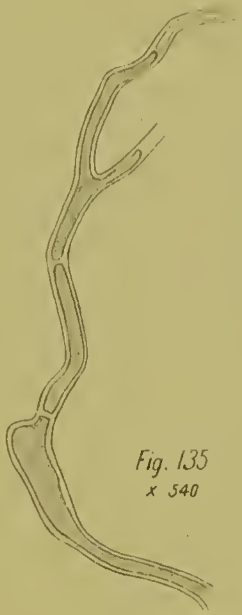


Fig. 135
x 540

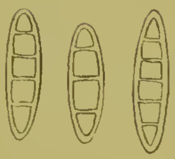


Fig 137

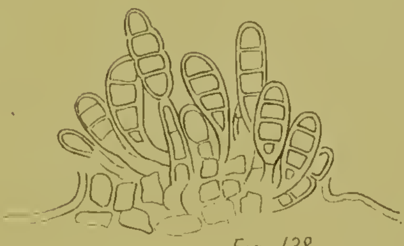


Fig. 138

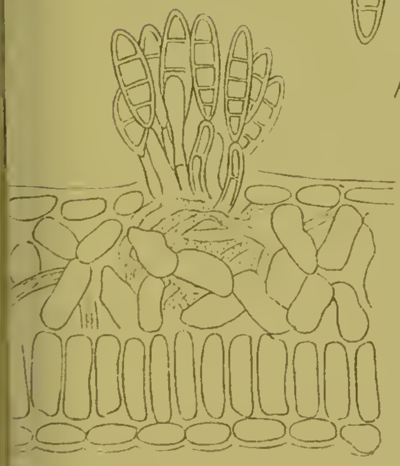


Fig. 136

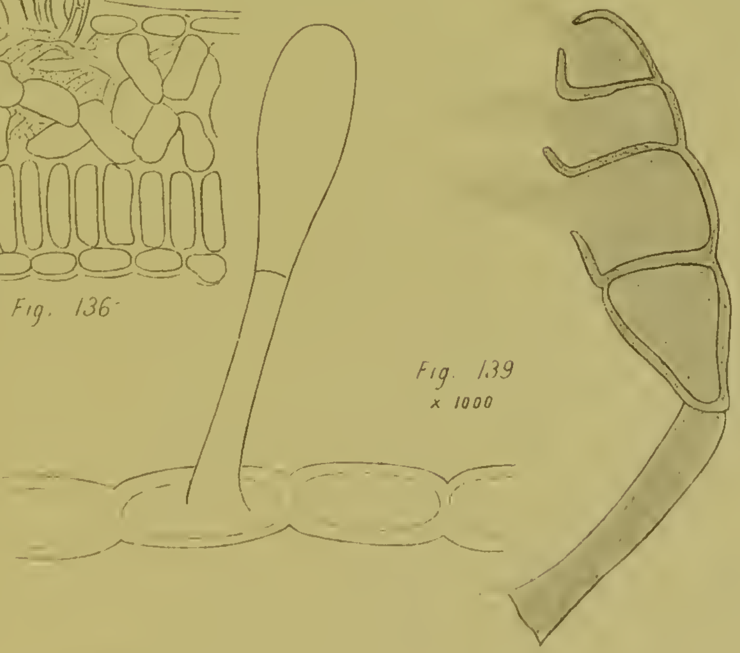


Fig. 139
x 1000

Plate XXXI

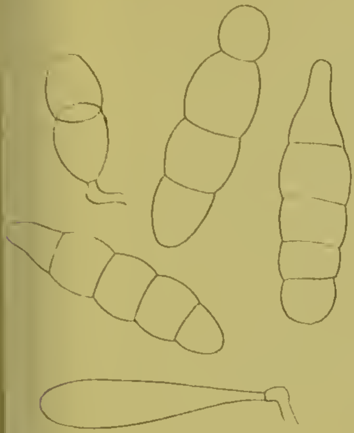


Fig 141
X 540

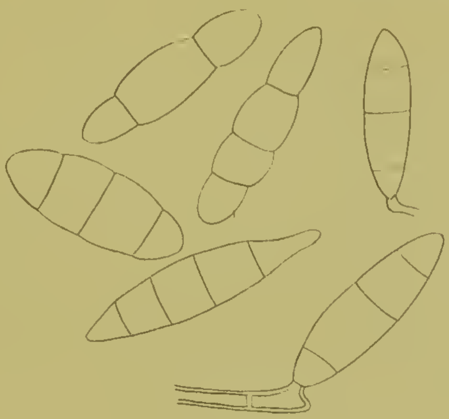


Fig. 142
X 540

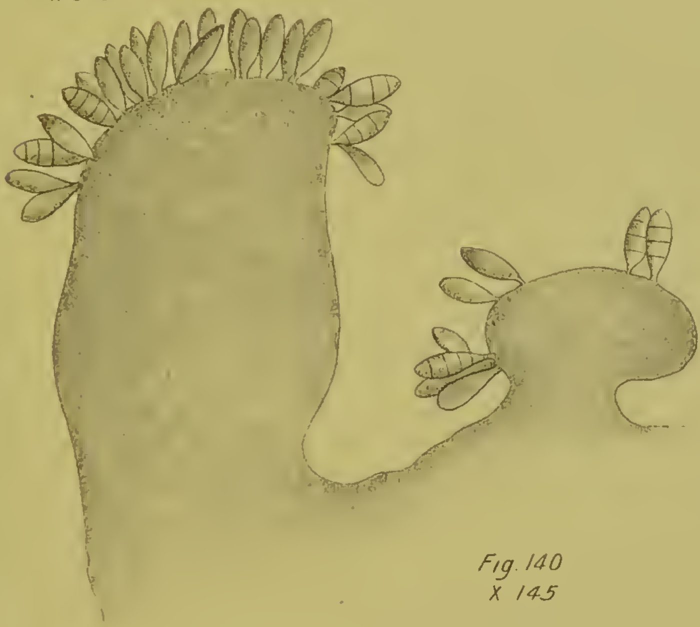


Fig. 140
X 145

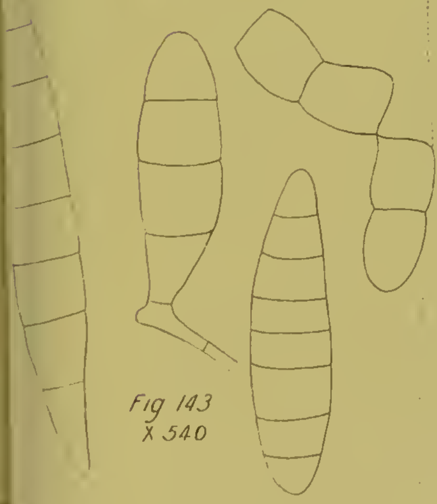


Fig 143
X 540

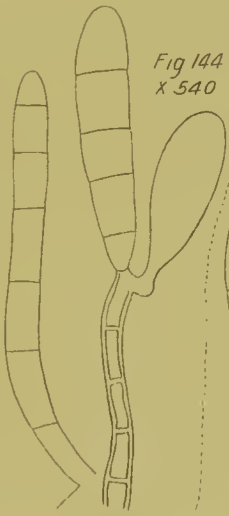


Fig 144
X 540

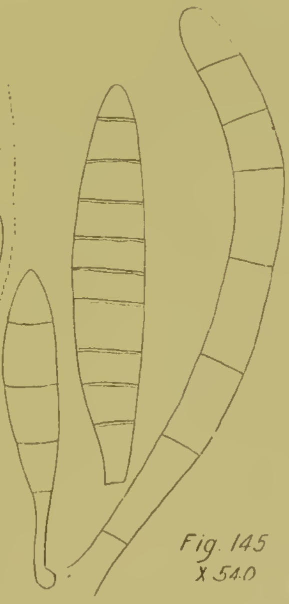


Fig. 145
X 540

Plate XXXII

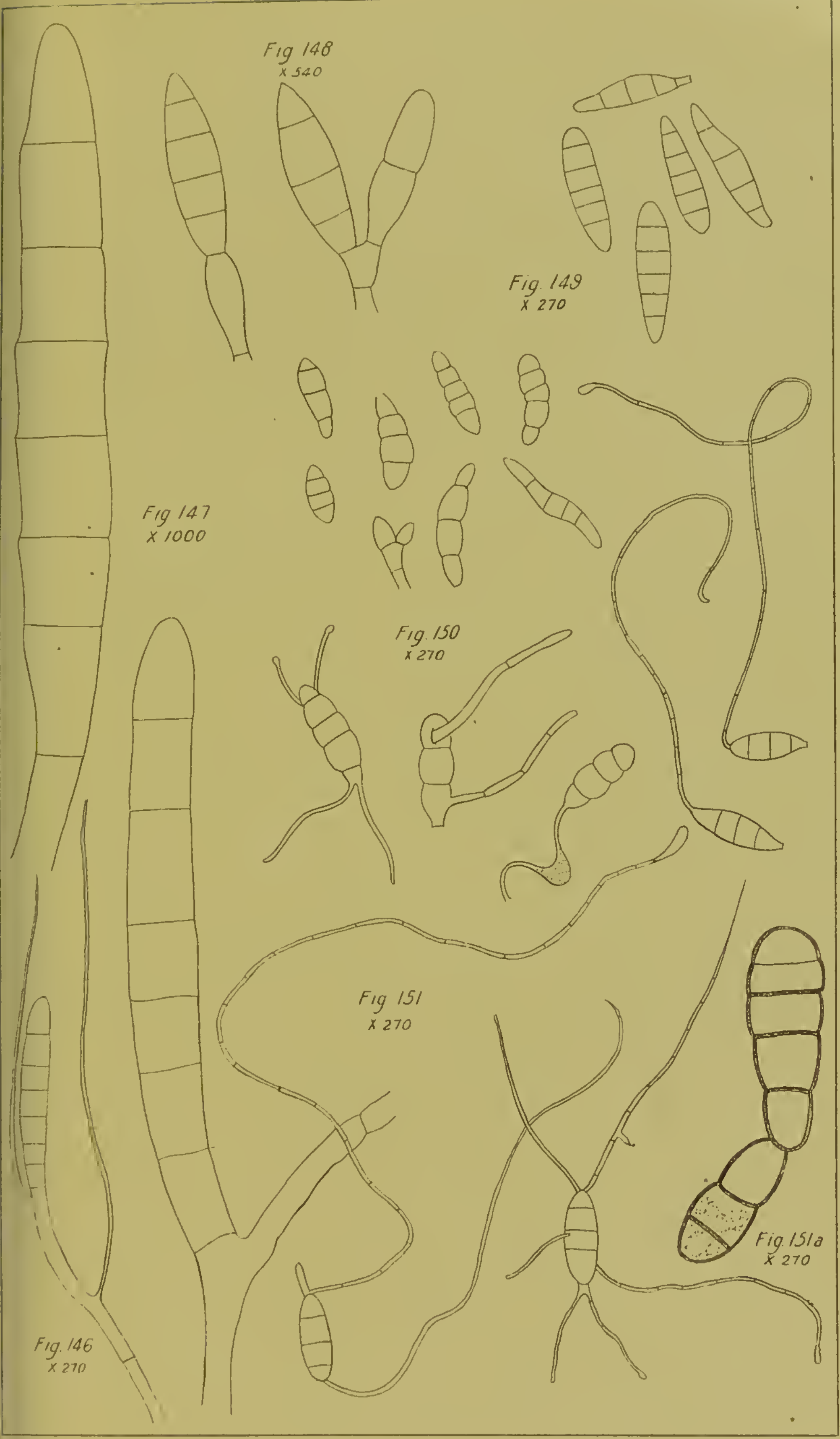


Fig 147 x 1000

Fig 148 x 540

Fig. 149 x 270

Fig. 150 x 270

Fig 151 x 270

Fig. 151a x 270

Fig. 146 x 270

Plate XXXIII

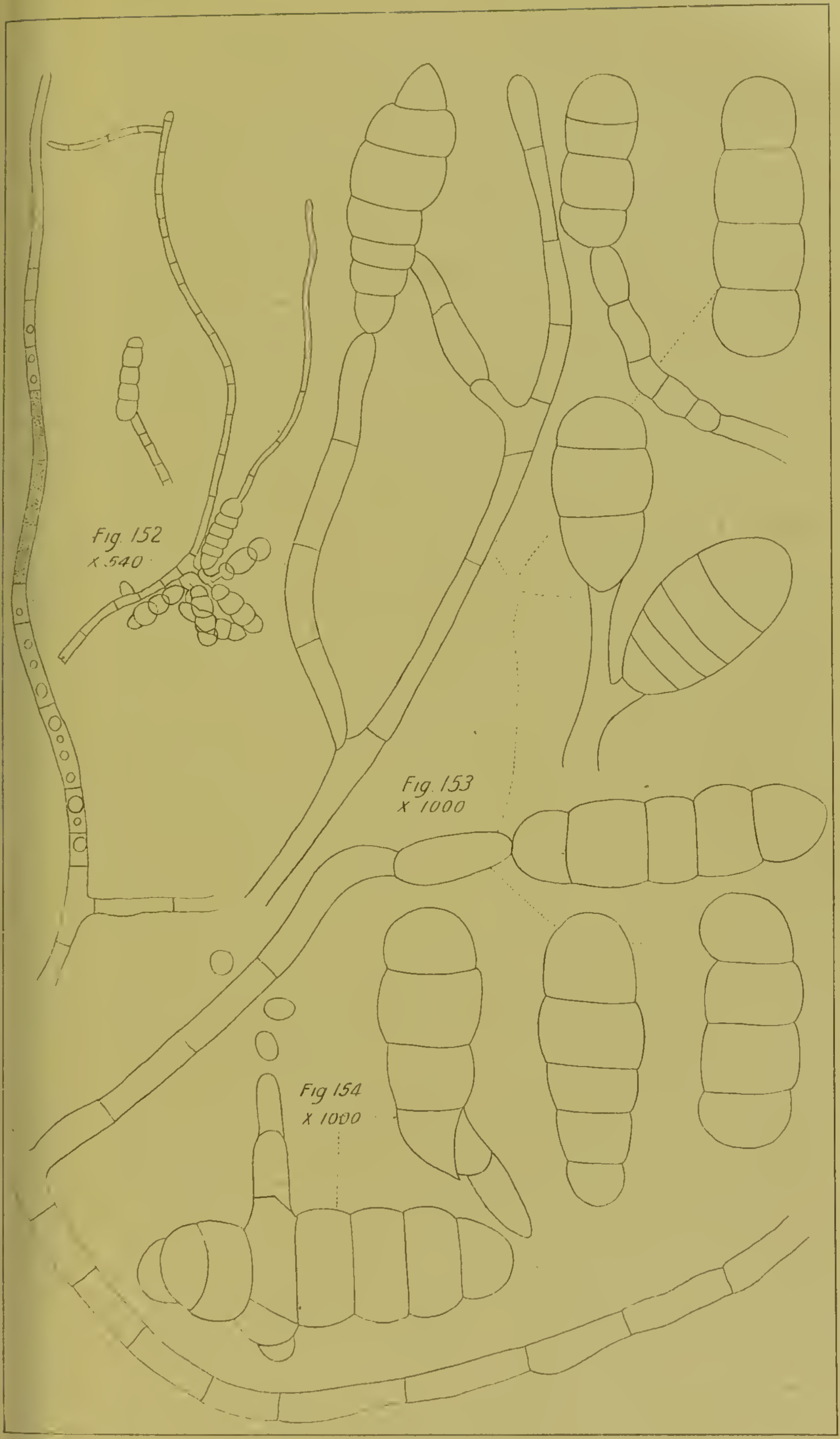


Fig. 152
x 540

Fig. 153
x 1000

Fig 154
x 1000

Plate XXXIV

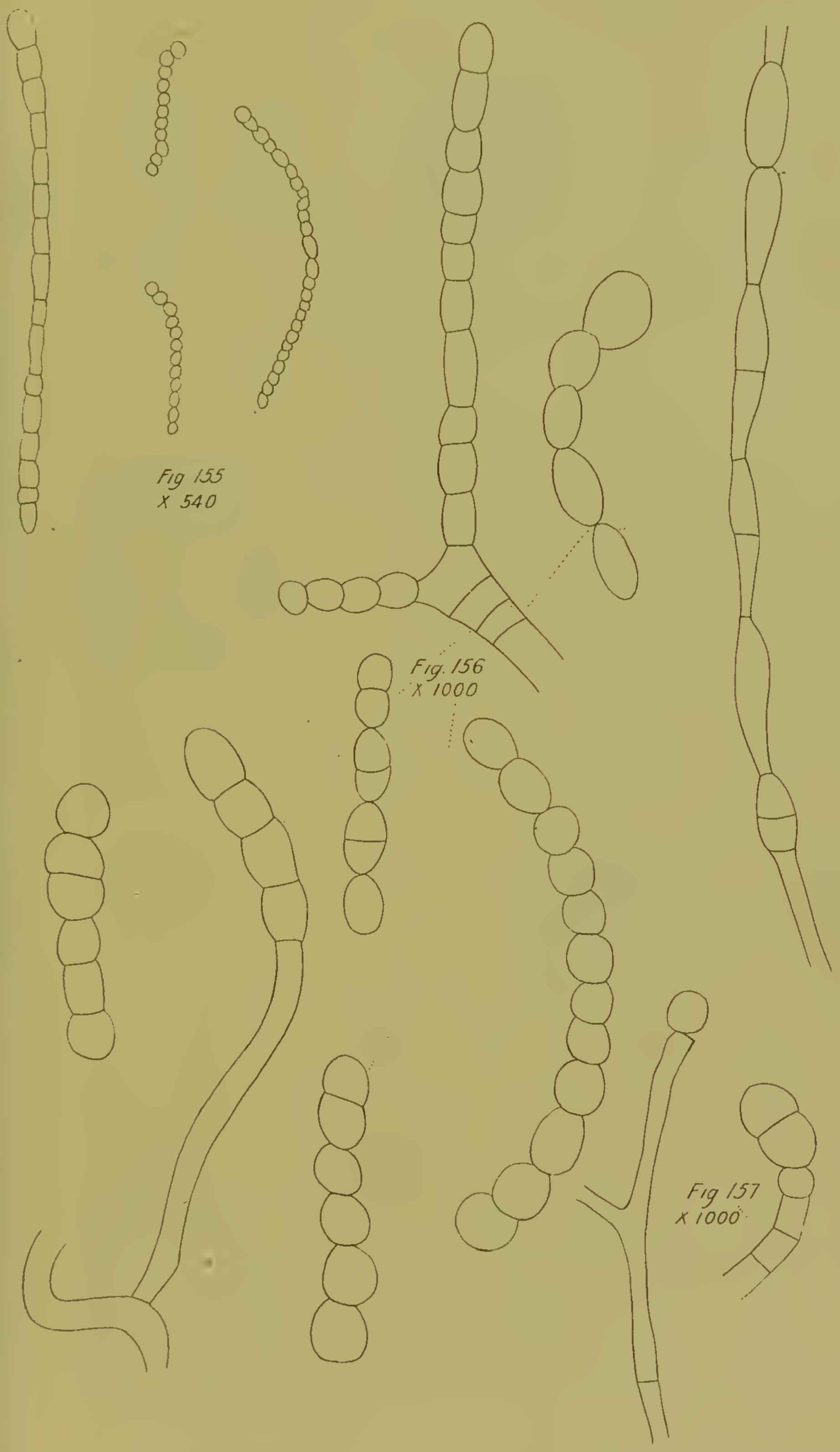


Fig 155
X 540

Fig. 156
X 1000

Fig 157
X 1000

Plate XXXV

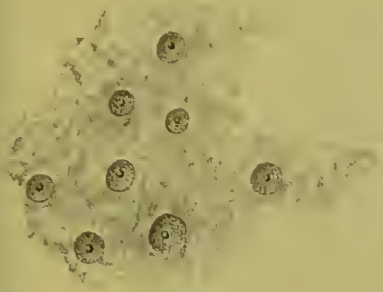


Fig 158
X 52

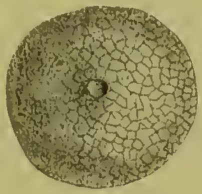


Fig. 159
X 145

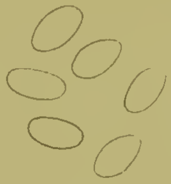


Fig 160
X 1000

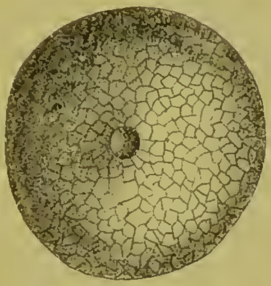


Fig 161
X 145

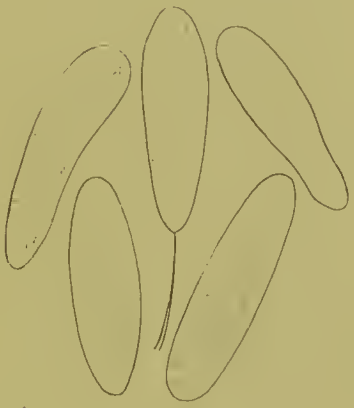


Fig 162
X 1000

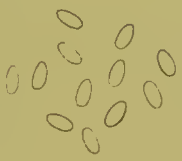


Fig 164
X 1000

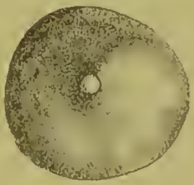


Fig 163
X 145

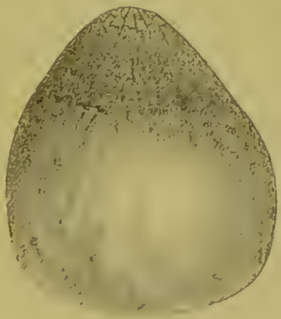


Fig 165
X 145

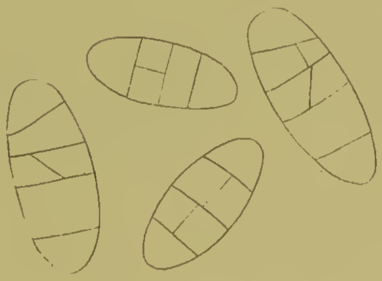


Fig 166
X 1000

Plate XXXVI

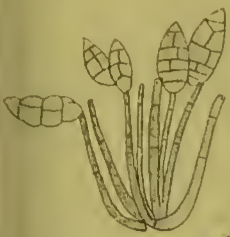


Fig 167
x 145

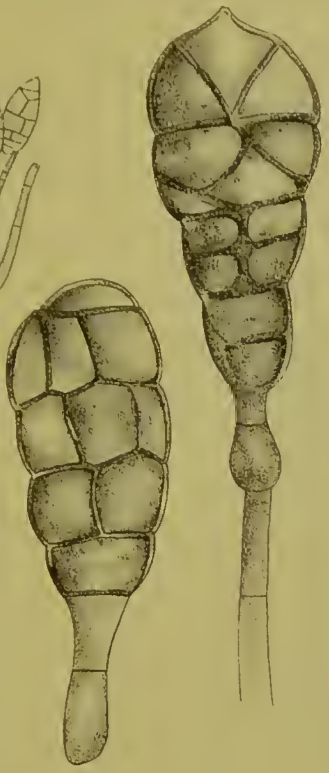


Fig. 168
x 1000

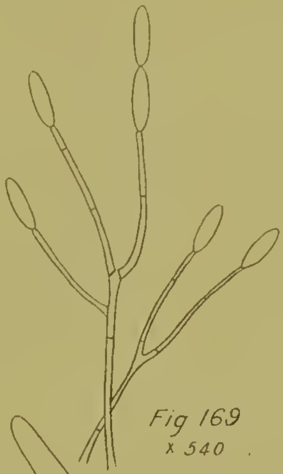


Fig 169
x 540

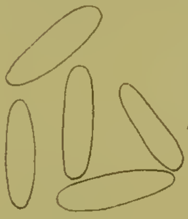


Fig 170 x1000

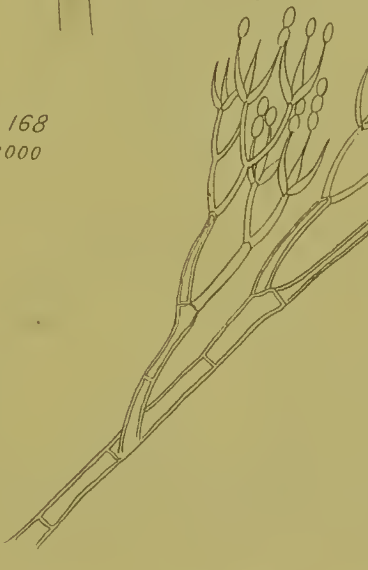


Fig 171
x 270

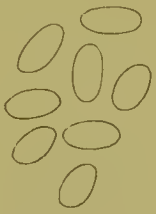


Fig 172
x 1000

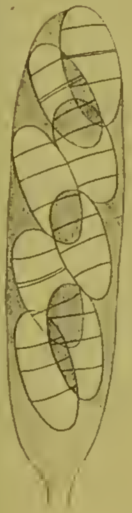


Fig 174
x 1000

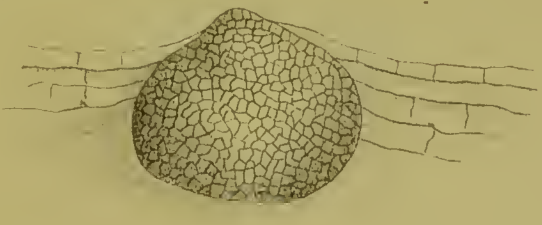


Fig 173
x 270

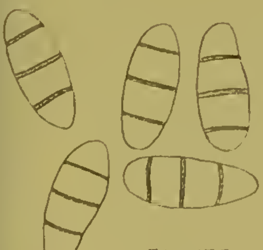
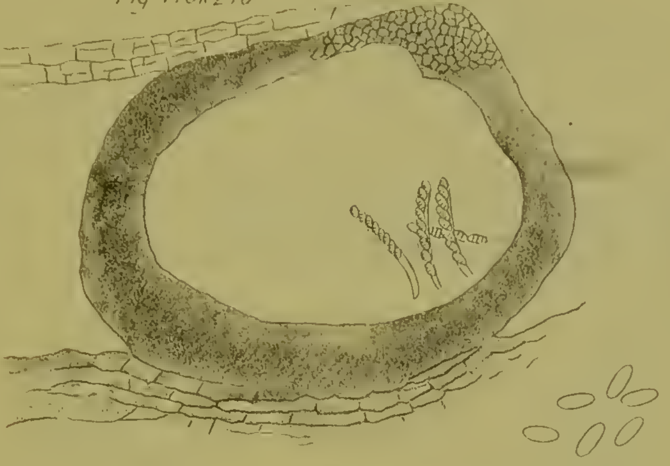


Fig 175
x 1000

Fig 176 x 270



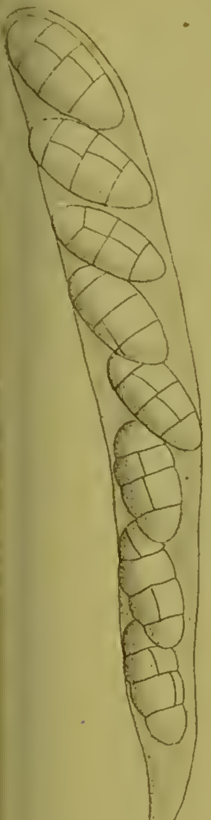


Fig 177
x 1000

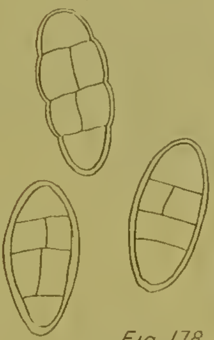


Fig. 178
x 1000

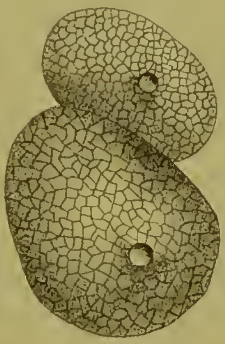


Fig 179
x 154

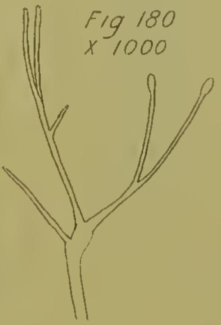


Fig 180
x 1000

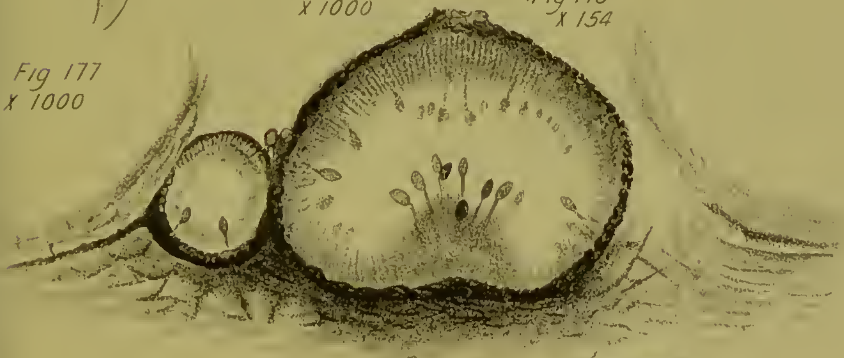


Fig 181
x 100

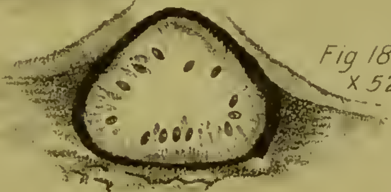


Fig 183
x 52

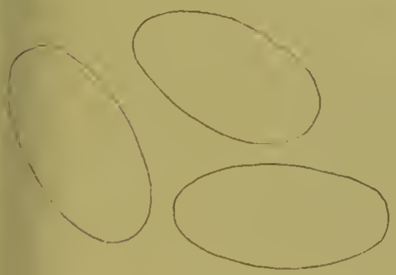


Fig 182
x 1000

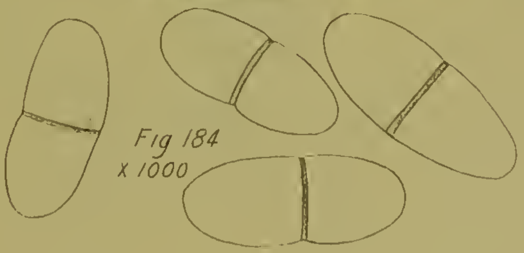
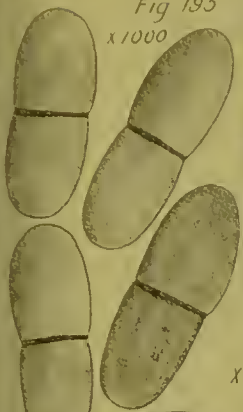


Fig 184
x 1000

Plate XXXVIII

Fig 195
x 1000



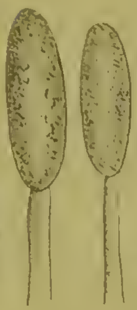


Fig 187
X 1000

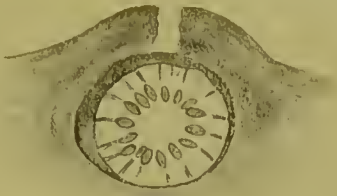


Fig 186 x 52

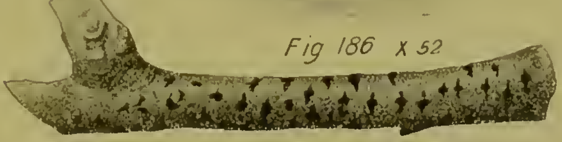


Fig. 185

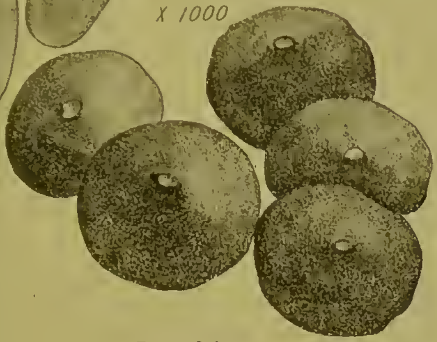


Fig 194
x 100

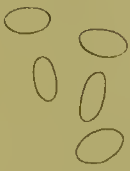


Fig. 190
x 1000

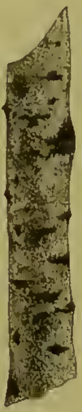


Fig 188

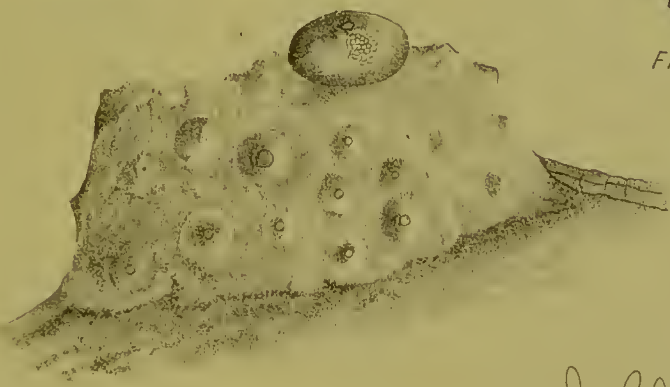


Fig 189
x 52

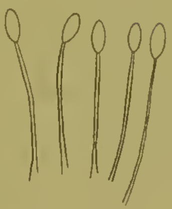
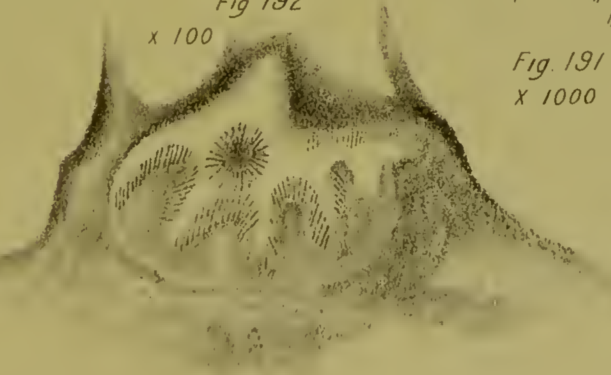


Fig. 191
x 1000

Fig 192
x 100



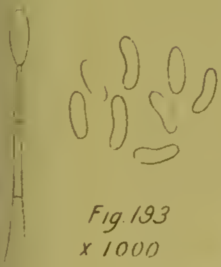


Fig. 193
x 1000

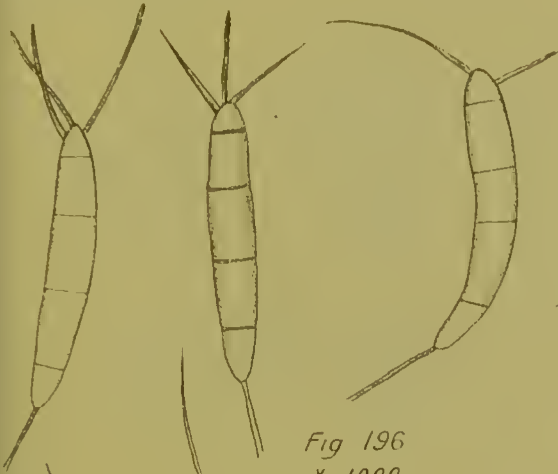


Fig 196
x 1000

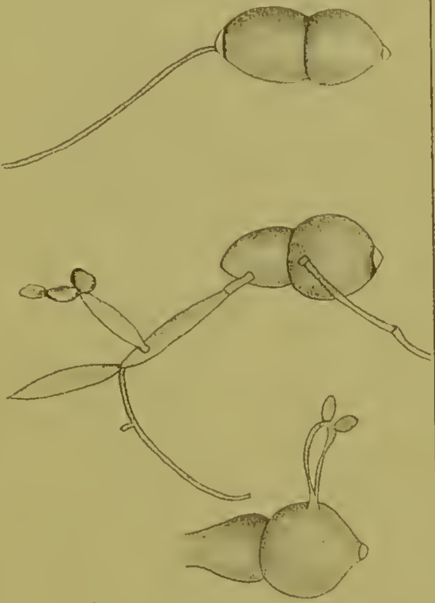


Fig. 198
x 1000

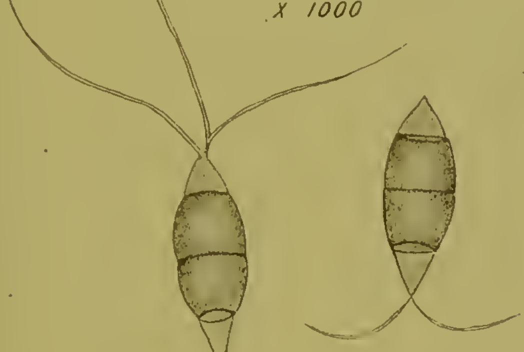


Fig 197
x 1000

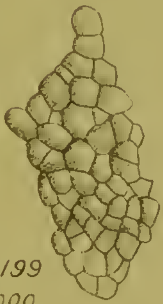


Fig. 199
x 1000

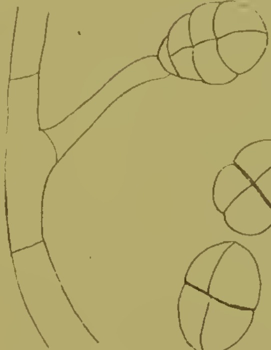


Fig 201
x 1000

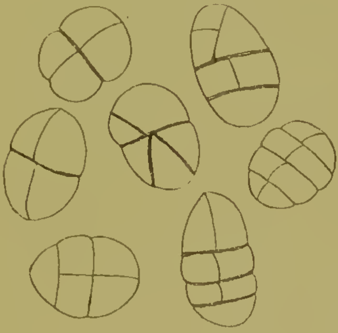


Fig 202
x 1000

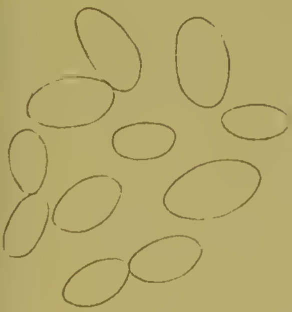


Fig 200
x 1000

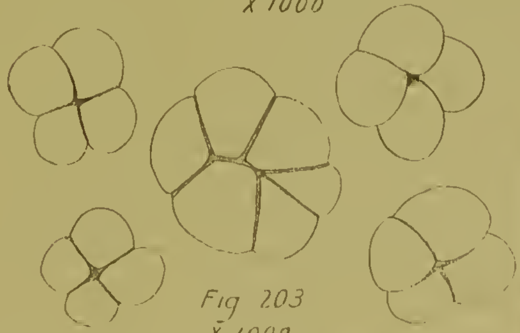


Fig 203
x 1000

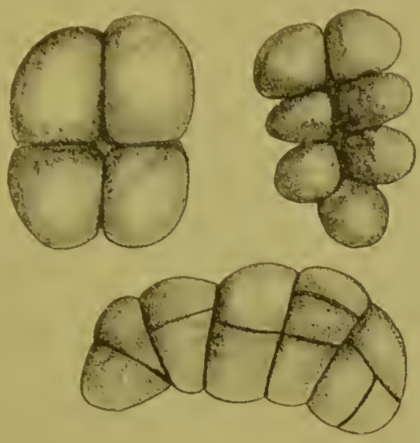


Fig 204
x 1000

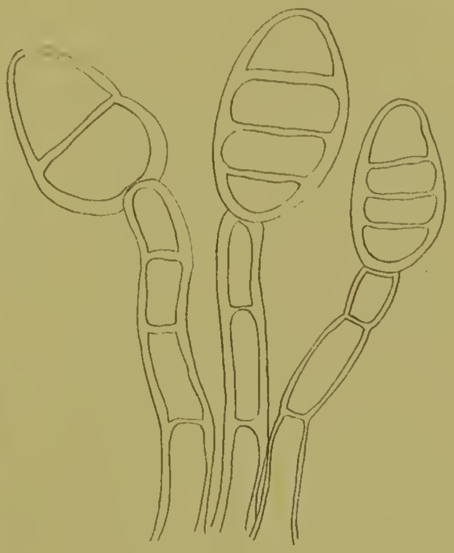


Fig. 205
x 1000

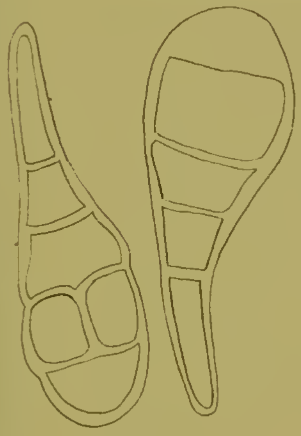


Fig. 206
x 1000

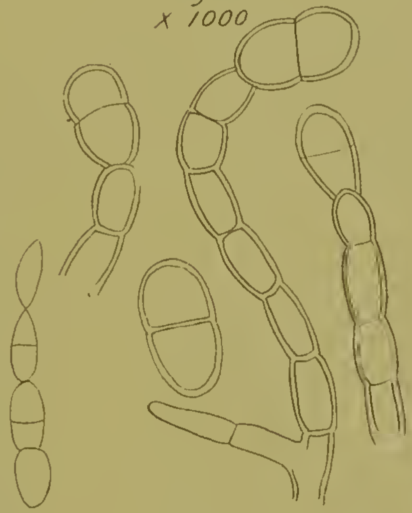


Fig. 207
x 1000

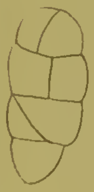


Fig. 210
x 1000

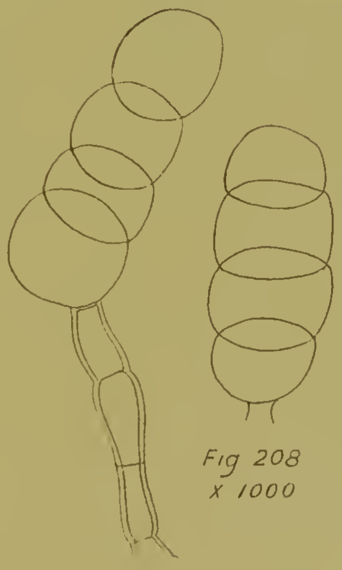


Fig 208
x 1000

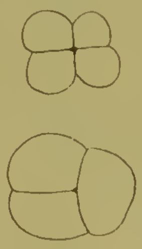


Fig 209
x 1000

Plate XLI

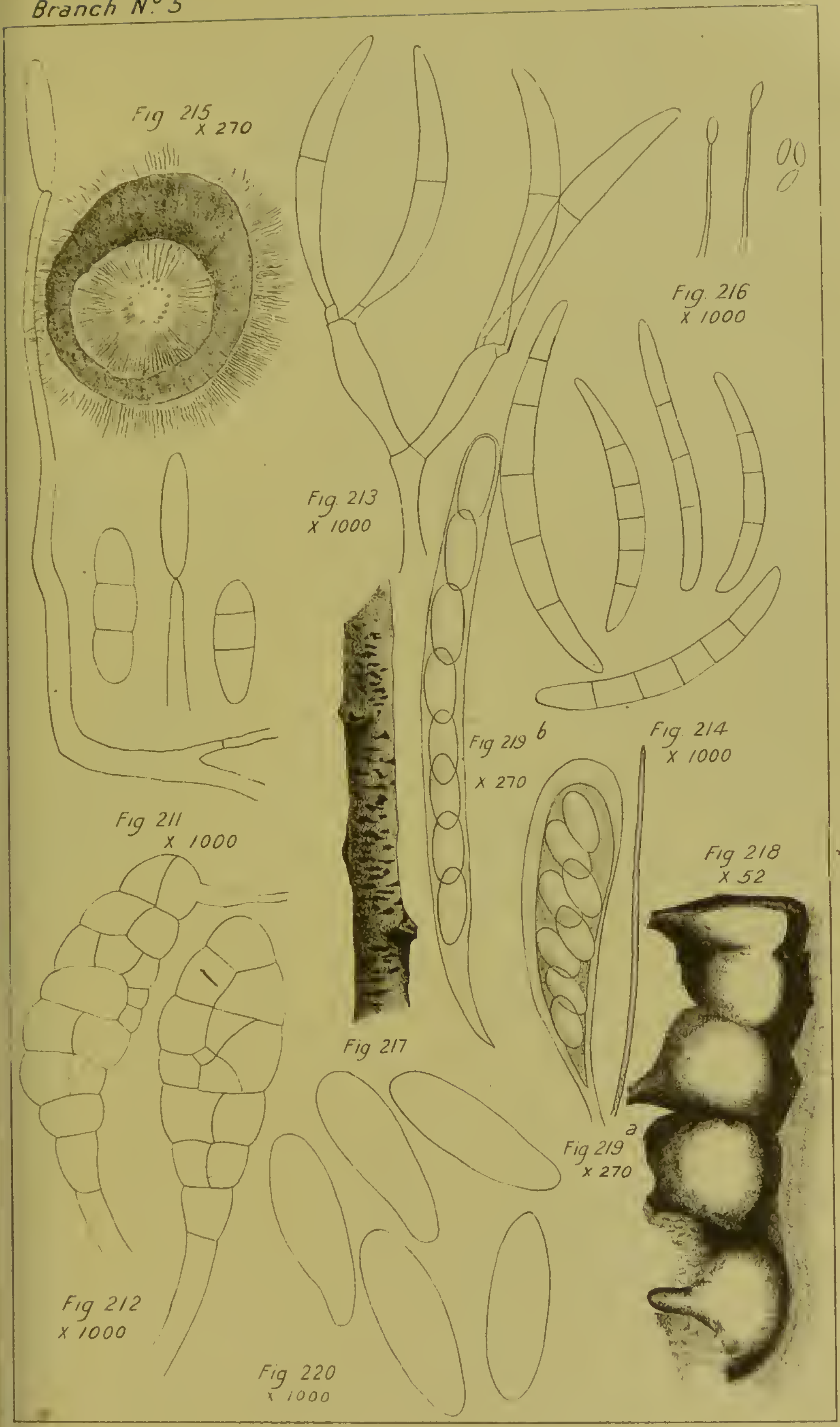


Fig 215 x 270

Fig. 216 x 1000

Fig. 213 x 1000

Fig 219 b x 270

Fig. 214 x 1000

Fig 211 x 1000

Fig 218 x 52

Fig 217

Fig 219 a x 270

Fig 212 x 1000

Fig 220 x 1000

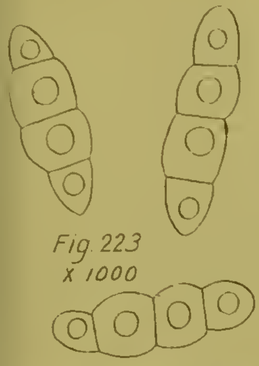


Fig. 223
x 1000

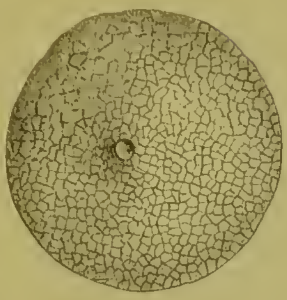


Fig 221 x 270

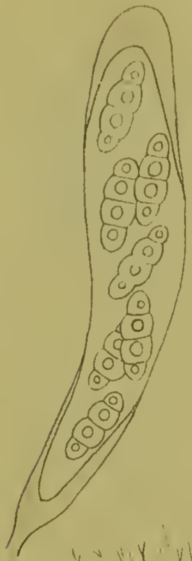


Fig. 222
x 540

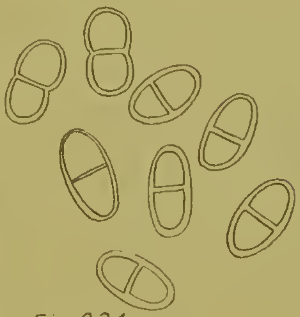


Fig. 234
x 1000

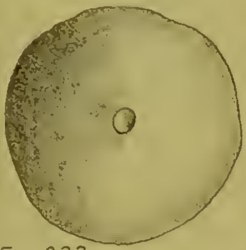


Fig 233
x 270

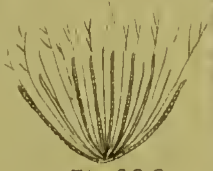


Fig 225
x 100

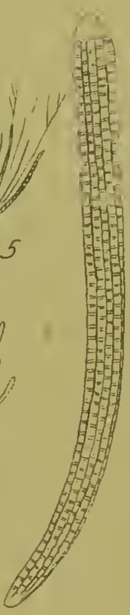


Fig. 226
x 540

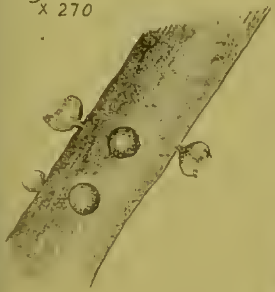


Fig 229 b
x 5

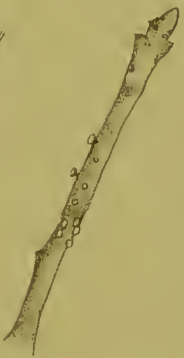


Fig. 229 a

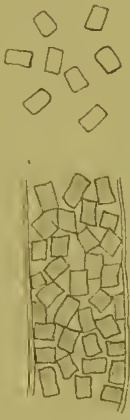


Fig. 228
x 1000

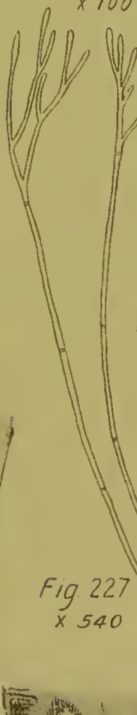


Fig. 227
x 540

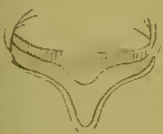


Fig 230
x 15

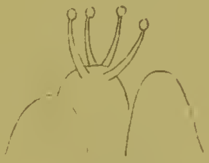


Fig. 231
x 540

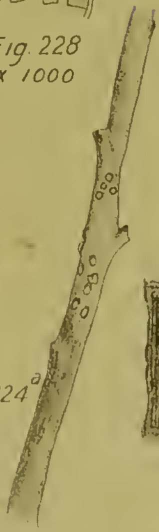


Fig 224 a

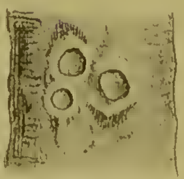


Fig. 224 b
x 4

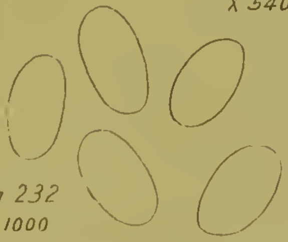


Fig 232
x 1000

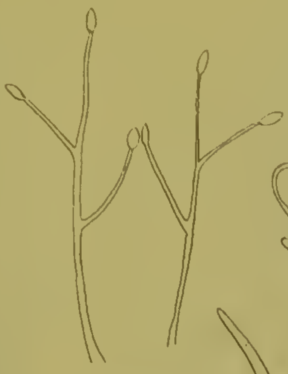


Fig. 235
x 1000

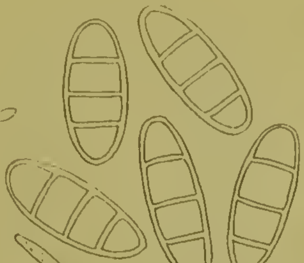


Fig. 237
x 1000

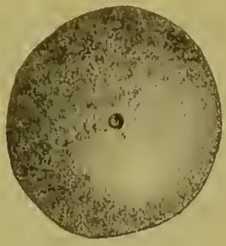


Fig 236
x 100

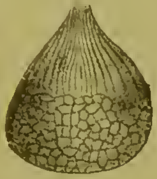


Fig 238
x 145

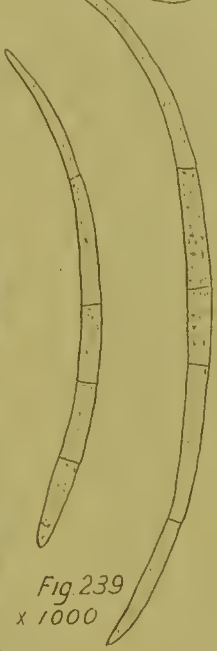


Fig. 239
x 1000

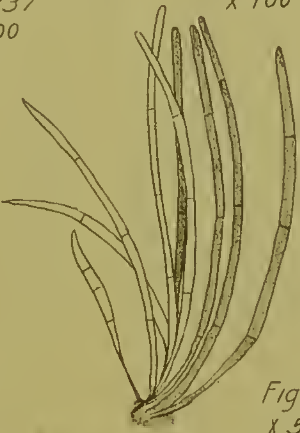


Fig 240
x 540

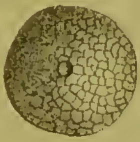


Fig 241
x 145

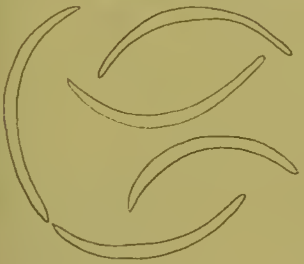


Fig. 242
x 1000

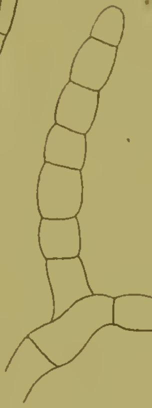


Fig. 243
x 1000

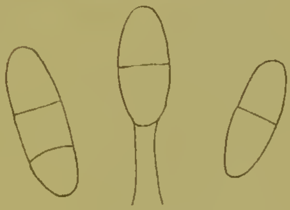


Fig. 244
x 1000

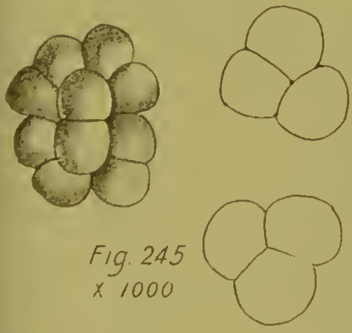


Fig. 245
x 1000

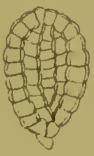


Fig 246
x 270

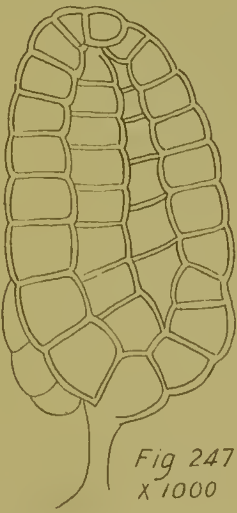


Fig 247
x 1000

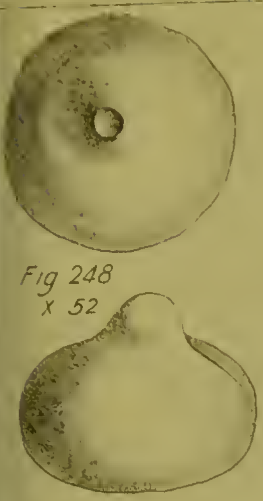


Fig 248
X 52

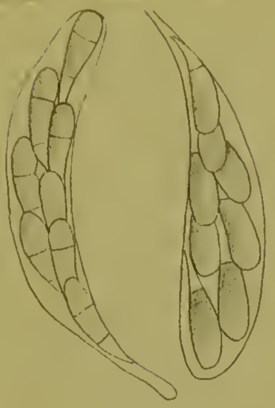


Fig 249
X 540

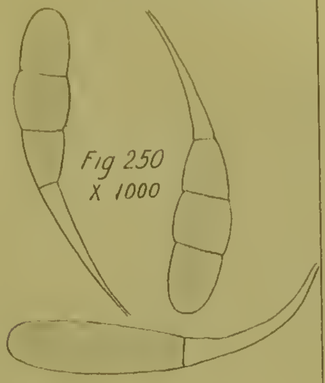


Fig 250
X 1000

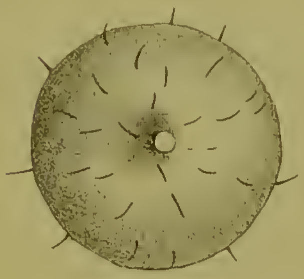
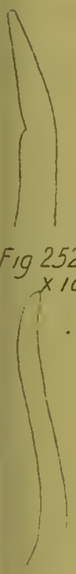


Fig 251
X 145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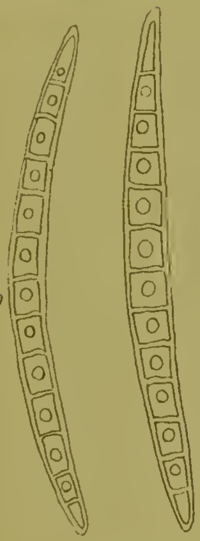
X 1000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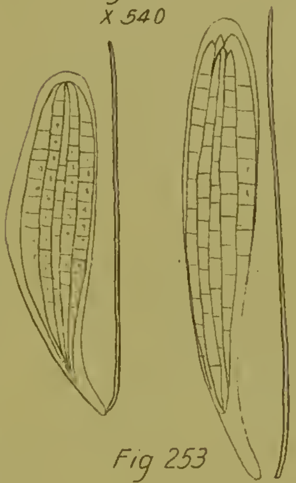
X 1000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X 540

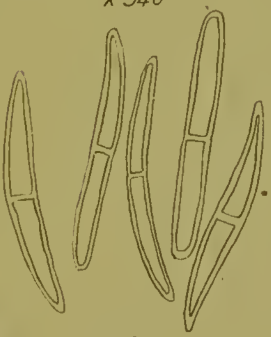


Fig 257
X 1000

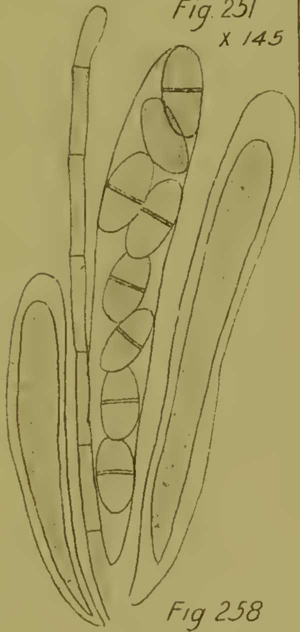


Fig 258
X 540

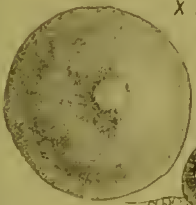


Fig 255ª
X 270

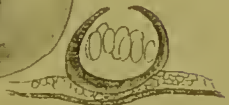


Fig. 255ᵇ
X 52

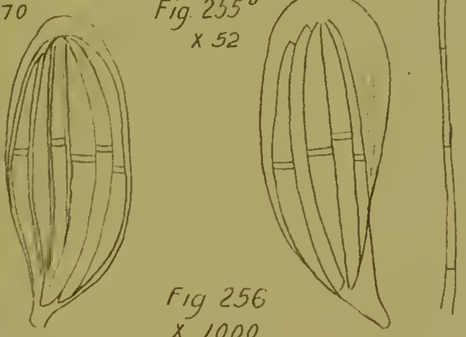


Fig 256
X 1000

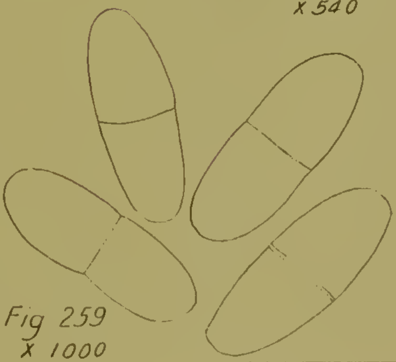


Fig 259
X 1000

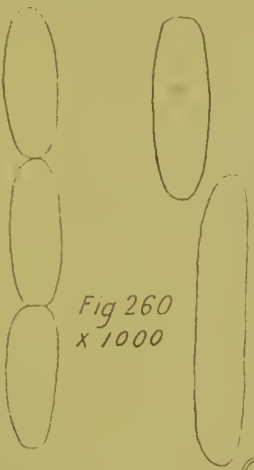


Fig 260
x 1000

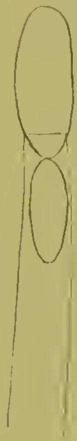


Fig 261
x 1000

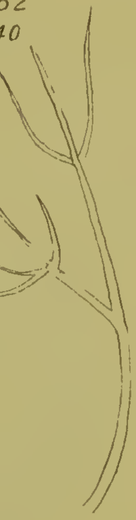


Fig 262
x 540

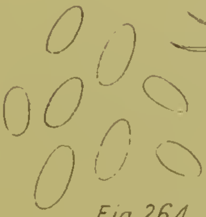


Fig. 264
x 1000

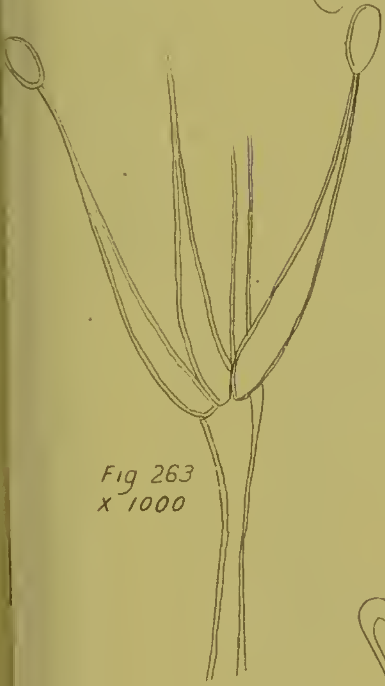


Fig 263
x 1000

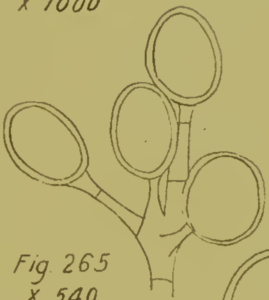


Fig. 265
x 540

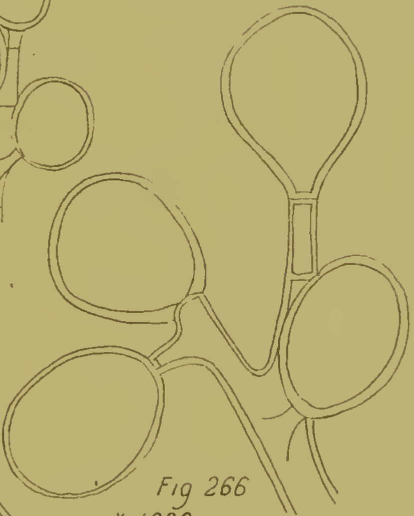
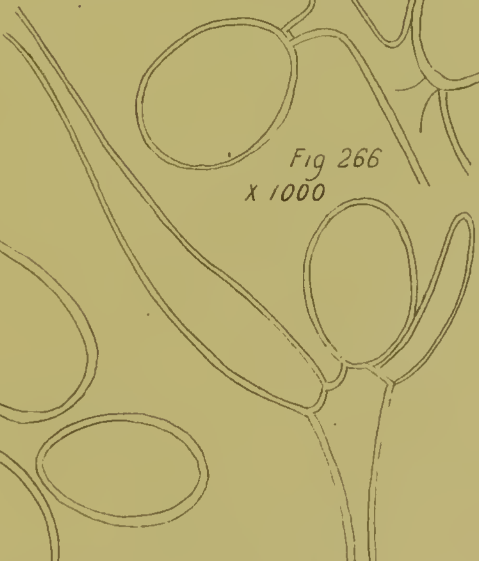


Fig 266
x 1000



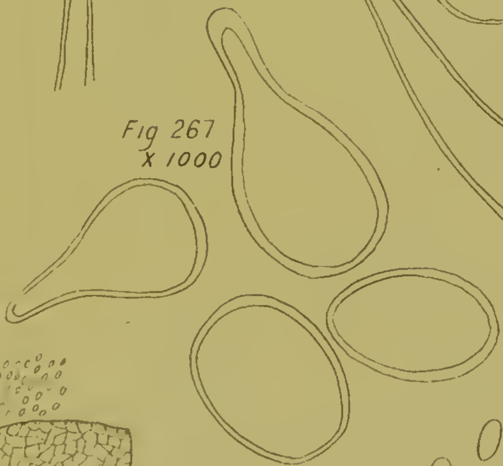


Fig 267
x 1000

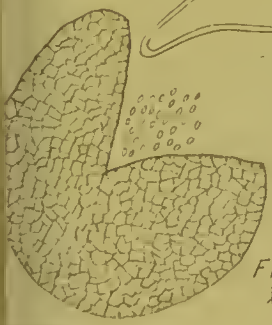


Fig 268
x 100

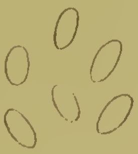


Fig 269
x 1000

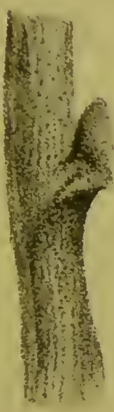


Fig. 271
x 2

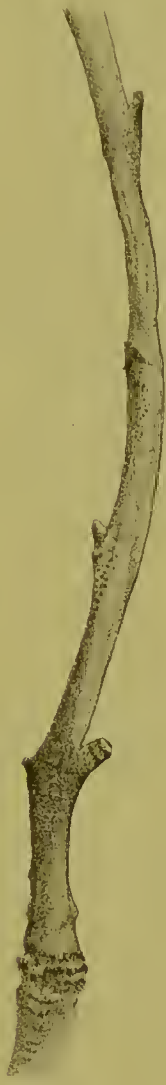


Fig. 270
Nat Size

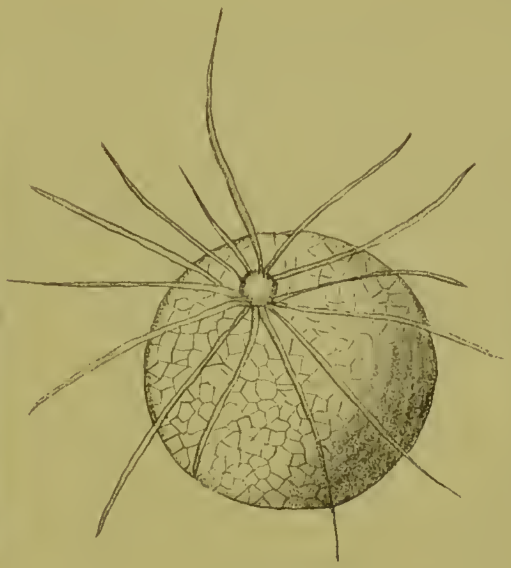


Fig 274
x 145

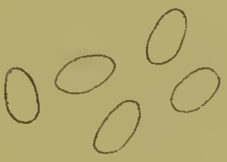


Fig 275
x 1000

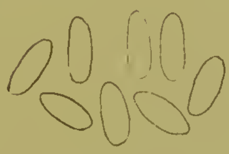


Fig 273
x 1000

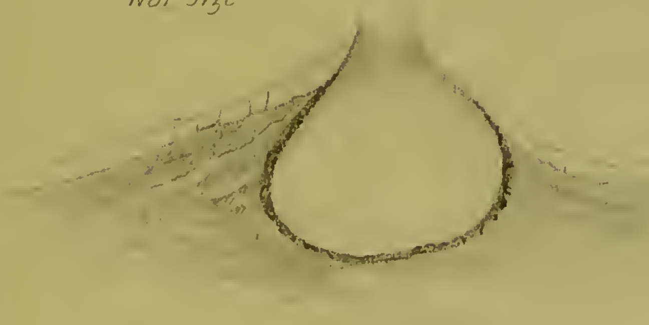


Fig. 272
x 100

EXPLANATION OF PLATES.

PLATE XV.

Rhizopus schizans.

Fig.
1. Sporangiferous hyphæ, with creeping root-like portions (× 90).
2. Spores (× 1000).

Phyllosticta vulgaris. var. *cerasi.*

3. Perithecium—surface view (× 145).
4. Spores (× 1000).

Coniothyrium pruni.

5. Perithecium—surface view (× 270).
6. Sporules (× 1000).

PLATE XVI.

Monilia fructigena.

Fig.
7. Branched and septate hyphæ, bearing conidia in chains (× 270).
8. Conidia detached (× 1000).

Monilia laxa.

9. Branching colourless hyphæ, sparingly septate (× 270).
10. Portion of same (× 1000).
11. Hyaline conidia (× 1000).

Verticillium lateritium.

12. Fertile, erect branching hyphæ with branchlets arranged in a whorl (× 145).
13. Branchlets with conidia at apex (× 540).
14. Conidia (× 1000).

PLATE XVII.

Cephalosporium fructigenum.

Fig.
15. Hyphæ, bearing terminal heads of conidia (× 1000).
16. Hypha, with lateral knob, bearing conidia (× 1000).
17. Conidia detached (× 1000).

Penicillium glaucum.

18. Branching conidiophore with chains of conidia (× 270).

Trichothecium roseum.

19. Fertile hypha, non-septate and bearing conidium at apex (× 1000).
20. Conidia detached (× 1000).

Dematium pullulans.

21. Radiating moniliform hyphæ springing from dark-brown clumps of cells (× 145).
22. Hypha with numerous colourless filaments radiating from segments and bearing terminal or lateral conidia (× 145).
23. Portions of hyphæ, bearing conidia terminally and laterally (× 1000).

PLATE XVIII.

Cladosporium carpophilum.

Fig.
24. Hyphæ, one of which shows young conidium at apex (× 1000).
25. Conidia detached, rarely septate (× 1000).

Clasterosporium carpophilum.

26. Conidia attached to short, septate, flexuous conidiophores (× 540).
27. Conidia of various sizes, up to 7-septate (× 1000).

Macrosporium epicarpium.

28. Conidia in optical section (× 1000).

PLATE XIX.

Macrosporium epicarpium—continued.

Fig.
29. Hyphæ septate and branching and often assuming H-shaped forms (× 1000).
30. Conidia detached (× 1000).
31. Cladosporium-stage, showing hyphæ bearing conidia (× 540).
32. Conidium mature (× 1000).

Epicoccum fructigenum.

33. Convex stroma, with conidia (× 270).
34. Conidia detached, one showing very short conidiophore (× 1000).

PLATE XX.

Rhizopus nigricans.

Fig.
35. Sporangiferous hyphæ with rhizoids (× 100).
36. Sporangiophores, with hemispherical or dome-shaped columella (× 145).
37. Spores (× 1000).
38. Zygospore between the two suspensors (× 145).
39. Zygospore mature and detached (× 145).

Phyllosticta prunicola.

40. Shrivelled Apricot, blackened with mould (natural size).
41. Small portion from surface of same, slightly magnified and showing cluster of perithecia (× 15).

Fusarium prunorum.

42. Conidia, with ribbed septa (× 1000).

Fusarium putaminum.

43. Branching conidiophore, with immature conidium at apex (× 1000).
44. Conidia (× 1000).

Ocularia cerasi.

45. Hyphæ, bearing colourless conidia (× 270).
46. Conidia detached (× 1000).

PLATE XXI.

Puccinia pruni.

Fig.
47. Uredospores (× 1000).
48. Teleutospores, one of which is 3-septate (× 1000).
49. Paraphyses (× 1000).

Gnomonia circumscissa.

Fig.
50. Perithecia—(*a*) Surface view; (*b*) side view showing beak (× 145).
51. Asci—(*a*) Elongated and slender; (*b*) short and stout (× 540).
52. Sporidia (× 1000).

PLATE XXII.

Pleospora aurea.

Fig.
53. Perithecium—surface view (× 145).
54. Ascus (× 1000).
55. Sporidia (× 1000).

Pleospora herbarum.

56. Perithecium—surface view (× 145).
57. Ascus (× 145).
58. Sporidia (× 1000).

Pleospora permunda.

59. Ascus (× 540).
60. Sporidium (× 1000).

Exoascus deformans.

61. Asci on surface of peach leaf, and closely crowded (× 1000).
(*a*) Germination of Ascospores (× 1000).

PLATE XXIII.

Rhizopus apiculatus.

Fig.
62. Portion of leaf with sporangiophores (slightly enlarged).
63. Sporangiophores with rhizoids (× 100).
64. Spores (× 1000).

Physarum calidris.

65. Sporangia on portion of leaf (natural size).
66. Sporangium (× 52).
67. Spores (× 1000).

Phyllosticta persicæ.

68. Perithecium—surface view (× 145).
69. Sporules (× 1000).

Phyllosticta prunicola.

70. Perithecia—(*a*) From plum leaf; (*b*) from apple leaf (× 270).
71. Irregular polygonal markings of perithecial wall (× 1000).
72. Sporules (× 1000).

Pyrenochæta rosella.

73. Perithecium, with radiating bristles round mouth (× 145).
74. Sporules (× 1000).

PLATE XXIV.

Ascochyta chlorospora.

Fig.
75. Perithecium—surface view (× 145).
76. Sporules (× 1000).

Ascochyta crystallina.

77. Perithecium—surface view (× 95).
78. Sporules (× 1000).

Darluca filum.

Fig.
79. Perithecia on surface of rust pustule of *Puccinia pruni* (× 52).
80. Perithecium in section (× 145).
81. Sporules (× 1000).

Didymochæta australiana.

82. Perithecium with bristles (× 145).
83. Sporules (× 1000).

Septoria effusa.

84. Perithecia, side view (× 145).
85. Sporules (× 1000).

PLATE XXV.

Septocylindrium bonordenii.

Fig.
86. Conidia (× 1000).

Cladosporium phyllophilum.

87. Branching upright hyphæ, bearing conidia (× 270).
88. Conidia detached (× 1000).

Cladosporium prunicolum.

89. Radiating conidiophores, with conidia attached (× 1000).
90. Conidia detached (× 1000).

PLATE XXVI.

Cladosporium condylonema.

Fig.
91. Tuft of conidiophores, bearing conidia (× 270).
92. Conidiophore, bearing lateral as well as terminal conidia (× 540).
93. Conidia, one of which is germinating (× 1000).

Macrosporium parasiticum.

94. Tuft of condiophores, bearing condia (× 270).
95. Conidiophore, with characteristic cup-shaped form at apex (× 1000).
96. Conidia, one of which is attached to apex of conidiophore (× 1000).

Alternaria pruni.

97. Conidiophores, bearing conidia terminally and laterally (× 270).
98. Conidia, detached (× 540).

Alternaria tenuis.

99. Tuft of conidiophores, bearing conidia in chains (× 540).
100. Chain of conidia (× 1000).

PLATE XXVII.

Rosellinia aurea.

Fig.
101. Ascus, with 8 spores (× 540).
102. Sporidia, showing turbid contents and hyaline at either end (× 1000).

Pleospora vulgaris.

103. Asci—(*a*) immature; (*b*) mature (× 540).
104. Sporidium, with longitudinal septa (× 1000).

Leptosphaerulina australis.

Fig.
105. Two perithecia, upper one showing asci through transparent wall (× 145).
106. Asci showing sporidia (× 540).
107. Sporidium (× 1000).

Phyllosticta matthiolana.

108. Perithecium—surface view (× 145).
109. Sporules, with one attached to basidium (× 1000).

Vermicularia angustispora.

110. Perithecia—(*a*) basal view, showing radiating bristles; (*b*) surface view.
111. Sporules (× 1000).

Sphaeropsis cerasifolia.

112. Perithecium—surface view (× 145).
113. Sporules (× 1000).

PLATE XXVIII.

Ascochyta ovalispora.

Fig.
114. Sporules (× 1000).

Kellermannia pruni.

115. Perithecium—surface view (× 145).
116. Sporules (× 1000).

Monilia olivacea.

117. Hypha, bearing conidia on tooth-like projections (× 1000).

Trichoderma racemosum.

118. End of branch bearing branchlets, with conidia in chains (× 540).
119. Branch with branchlets at right angles, or nearly so (× 540).
120. Chain of conidia (× 540).
121. Detached conidia (× 1000).

Langloisula rubigo-spora.

122. Fertile erect conidiophore (× 270).
123. Branchlets, to which conidia are attached (× 1000).
124. Conidia detached (× 1000).

Hormiscium undulatum.

125. Short hypha, bearing long wavy chains of conidia (× 270).
126. Three terminal conidia (× 1000).

PLATE XXIX.

Dematium pullulans.

Fig.
127. Marginal fragment of excised portion of Apricot leaf, showing compact spherical pustules, producing filaments, basidia, and spores (× 52).
128. Single spherical pustule of same (× 270).
129. Portions of filaments, with basidia and spores (× 1000).
130. Filament, with swollen terminal end bearing spores (× 1000).
131. Terminal end of basidium; with spores (× 1000).
132. Spores germinating in a yeast-like manner (× 1000).
133. Filaments bearing conidia laterally (× 1000).

PLATE XXX.

Dematium pullulans—continued.

Fig.
134. Tubercular mass of dense honey-coloured hyphae from apple leaf, bearing conidia at apex (× 270).
135. Isolated filament from same (× 540).

Clasterosporium carpophilum.

136. Section of almond-leaf with tuft of conidia bursting through epidermis (highly magnified). (After Briosi and Cavara.)
137. Three conidia of same (highly magnified). (After Briosi and Cavara.)
138. Tuft of conidia of *Coryneum beyerinckii,* Oud., bursting through (highly magnified). (After Prillieux.)
139. Young and germinating conidia of *C. carpophilum* (× 1000).

PLATE XXXI.

Clasterosporium carpophilum.

Fig.
140. Tubercular mass of hyphæ bursting through epidermis, and bearing conidia at apex (× 145).
141. Various conidia of different ages and sizes (× 540).
142. Conidia from peach twig (× 540).
143. Conidia from almond leaf (× 540).
144. Conidia from apricot leaf (× 540).
145. Conidia from peach leaf (× 540).

PLATE XXXII.

Clasterosporium carpophilum—continued.

Fig.
146. Conidiophore with terminal olivaceous conidium (× 270).
147. Two conidia (× 1000).
148. Condiophores from peach leaf, bearing one and two conidia (× 540).
149. Detached conidia from same leaf (× 270).
150. Conidia from peach twig, irregularly shaped (× 270).
151. Germinating conidia from three-weeks'-old Apricot leaves, showing germ tubes being produced terminally or laterally (× 270).
151A. Conidium directly producing a secondary conidium from base (× 540).

PLATE XXXIII.

Clasterosporium carpophilum—continued.

Fig.
152. Hyphæ and conidia, showing a tuft borne laterally on the creeping hypha (× 540).
153. Conidia at various stages, atttached and detached, constricted and not constricted, at the septa (× 1000).
154. Mature forms of conidia, some of which are germinating (× 1000). All these forms were found on a single "shot hole" spot.

PLATE XXXIV.

Chain gemmæ, frequently associated with *C. carpophilum* and *P. prunicola.*

Fig.
155. Detached portions of chain (× 540).
156. Chain and various forms of gemmæ (× 1000).
157. Hyphae bearing conidia at different stages (× 1000).

PLATE XXXV.

Capnodium armeniacæ.

Fig.
158. Surface view of perithecia imbedded in black matrix, peeling off (× 52).
159. Perithecium—surface view (× 145)
160. Sporules (× 1000).

Phyllosticta macrospora.

161. Perithecium—surface view (× 145).
162. Sporules (× 1000).

Phyllosticta chlorospora.

163. Perithecium—surface view (× 145).
164. Sporules (× 1000).

Camarosporium prunifolium.

165. Perithecium—side view (× 145).
166. Sporules (× 1000).

PLATE XXXVI.

Macrosporium prunicolum.

Fig.
167. Conidiophores with conidia (× 145).
168. Conidia detached (× 1000).

Tubercularia olivacea.

169. Branching conidiophores, with conidia (× 540).
170. Conidia (× 1000).

Penicillium roseum.

171. Branching conidiophore, bearing chains of conidia at apex of branchlets (× 270).
172. Conidia (× 1000)

Sphærulina pruni.

173. Perithecium immersed (× 270).
174. Ascus (× 1000).
175. Sporidia (× 1000).

PLATE XXXVII.

Pleospora armeniacæ.

Fig.
176. Perithecium in section, showing a few asci (× 270).
177. Ascus, with 8 sporidia (× 1000).
178. Sporidia (× 1000).

Dendrophoma pulvis-pyrius.

179. Two perithecia—surface view (× 145).
180. Sporules attached to branching basidia, and detached (× 1000).

Haplosporella pruni.

181. Perithecia, bursting through epidermis, and in section (× 100).
182. Sporules (× 1000).

Diplodia malorum

183. Perithecium in section (× 52).
184. Sporules (× 1000).

PLATE XXXVIII.

Dothiorella amygdali.

Fig.
185. Portion of twig with pustules rupturing bark transversely (natural size).
186. A single perithecium, in section, showing sporules attached to basidia (× 52).
187. Sporules with basidia (× 1000).

Dothiorella microspora.

188. Portion of twig with bark transversely ruptured (natural size).
189. Surface of stroma, with imbedded perithecia (× 52).
190. Sporules (× 1000).

Cytosporella armeniacæ.

191. Sporules attached to basidia (× 1000).

Cytospora leucostoma.

192. Stroma in section, with perithecium bursting through (× 100).
193. Sporules and septate basidium (× 1000).

Botryodiplodia pruni.

194. Surface view of cluster of perithecia (× 100).
195. Sporules (× 1000).

PLATE XXXIX.

Kellermannia pruni.

Fig.
196. Conidia (× 1000).

Pestalozzia guepini.

197. Conidia (× 1000).
198. Germinating conidia (× 1000).

Oospora roseo-basis.

199. Pavement of cells (× 1000).
200. Conidia (× 1000).

Sporodesmium subcuticulare.

201. Conidia attached (× 1000).
202. Conidia detached (× 1000).

Coniothecium cerasi.

203. Conidia (× 1000).

PLATE XL.

Coniothecium olivaceum.

Fig.
204. Conidia (× 1000).

Macrosporium commune.

205. Conidia attached (× 1000).
206. Conidia detached (× 1000).
Showing obovate and clavate conidia.

Macrosporium persicinum.

207. Cladosporium-stage—Conidia (× 1000).
208. Helminthosporium-stage—Conidia (× 1000).
209. Coniothecium-stage—Conidia (× 1000).
210. Macrosporium-stage—Conidium (× 1000).

PLATE XLI.

Macrosporium uredinis.

Fig.
211. Cladosporium-stage—Conidia (× 1000).
212. Macrosporium-stage—Conidia, one of which is germinating (× 1000).

Fusarium roseum.

213. Conidiophores bearing immature conidia (× 1000).
214. Conidia mature and detached (× 1000).

Glutinium lævatum.

215. Perithecium in transverse section, showing sporules attached to basidia inside, and similar basidia spread outside (probably produced in process of mounting (× 270).
216. Sporules attached to basidia and detached (× 1000).

Botryosphæria pruni.

217. Portion of twig showing splitting of bark by fungus (natural size).
218. Perithecia in section (× 52).
219. Asci—(*a*) short and stout with paraphysis (× 270); (*b*) elongated and slender (× 270).
220. Sporidia (× 1000).

PLATE XLII.

Leptosphæria vagabunda.

Fig.
221. Perithecium—surface view (× 270).
222. Ascus (× 540).
223. Sporules (× 1000).

Schizoxylon lividum.

224. (*a*) Portion of twig, with fungus (natural size); (*b*) Portion of same (× 4).
225. Tuft of asci, with paraphyses (× 100).
226. Ascus, with 8 sporidia, breaking up into joints (× 540).
227. Paraphyses, showing furcate branching at apex (× 540).
228. Portion of ascus, with joints broken up (× 1000).

Cyphella marginata.

229. (*a*) Portion of twig, with fungus (natural size); (*b*) Portion of same (× 5).
230. Section through cup (× 15).
231. Basidia, with one bearing young spores on sterigmata (× 540).
232. Detached spores (× 1000).

Diplodia microsporella.

233. Perithecium—surface view (× 270).
234. Sporules (× 1000).

PLATE XLIII.

Fusicoccum persicae.

Fig.
235. Basidia, alternately branched and bearing conidia (× 1000).

Hendersonia persicae.

236 Perithecium—surface view (× 100).
237. Sporules (× 1000).

Cornularia pyriformis.

Fig.
238. Perithecium—side view (× 145).
239. Sporules (× 1000).
240. Tuft of sporules and olivaceous filaments springing from the same base (× 540).

Rhabdospora corticola.

241. Perithecium—surface view (× 145).
242. Sporules (× 1000).

Brachysporium excorians.

243. Branching conidiophore (× 1000).
244. Conidia, attached and detached (× 1000).

Coniothecium albo-cinctum.

245. Conidia of various shapes and sizes (× 1000).

Dictyosporium elegans.

246. Compound conidium (× 270).
247. Compound conidium (× 1000).

PLATE XLIV.

Rebentischia massalongi.

Fig.
248. Perithecia—surface and side view (× 52).
249. Asci (× 540).
250. Sporidia (× 1000).

Acanthostigma curvisetum.

251. Perithecium, with bristles—surface view (× 145).
252. Curved bristles (× 1000).
253. Asci, with accompanying paraphyses (× 540).
254. Sporidia (× 1000).

Didymella fusispora.

255. Perithecia—(*a*) Surface view (× 270); (*b*) sectional view (× 52).
256. Two asci, with paraphysis (× 1000).
257. Sporidia (× 1000).

Didymosphæria cerasorum.

258. Mature and immature asci, with paraphyses (× 540).
259. Sporidia (× 1000).

PLATE XLV.

Cylindrium intermixtum.

Fig.
260. Conidia, in chains and detached (× 1000).
261. Conidiophore (× 1000).

Verticillium candidulum.

262. Fertile erect branching hyphæ, with branchlets arranged in a whorl (× 540).
263. Portion showing whorl with conidia attached (× 1000).
264. Conidia detached (× 1000).

Coniosporium radicicolum.

Fig.
265. Portion of branching conidiophore (× 540).
266. Conidiophore bearing conidia (× 1000).
267. Conidia, with some tapering into more or less elongated stalks (× 1,000).

Phoma radicicola.

268. Perithecium—surface view (× 100).
269. Sporules (× 1000).

PLATE XLVI.

Phoma persicae.

Fig.
270. Peach twig, showing perithecia adjoining buds (natural size).
271. Portion of same (× 2).
272. Perithecium in section (× 100).
273. Sporidia (× 1000).

Pyrenochaeta radicina.

274. Perithecium, oblique view (× 145).
275. Sporidia (× 1000).

PLATE XLVII.

Phyllosticta prunicola.

Fig.

276. Portion of spot on apricot leaf in which two perithecia are embedded, from which the sporules are issuing in tendrils. The slight blurring at base of tendrils indicates motion still continuing. Photographed two minutes after placing in water when motion had nearly ceased (× 25).

277. Same as 276, two minutes afterwards, when all sporules had been ejected from the perithecia (× 25).

278, 279, 280, 281, 282. Various types of perithecia, with one, two, and three mouths, produced superficially on spots on apricot leaf, after remaining six days in moist chamber (× 100).

283. Sporules, from 276 and 277, twenty-four hours later, when the sporules forming the tendrils had become separated (× 200).

PLATE XLVII.

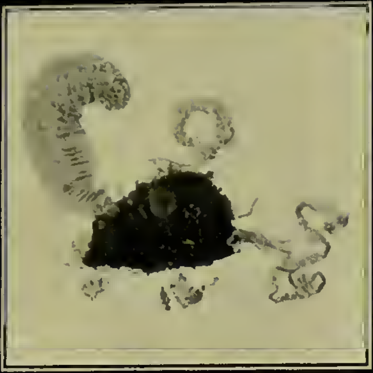


FIG. 276. X 25.

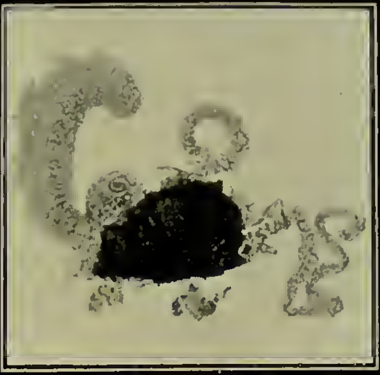


FIG. 277. X 25.

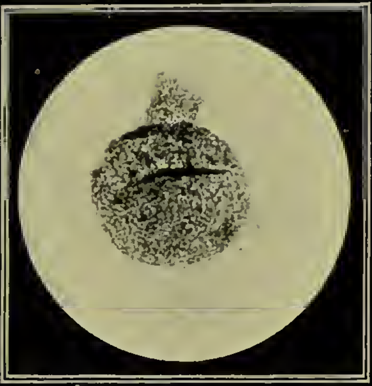


FIG. 278. X 100.

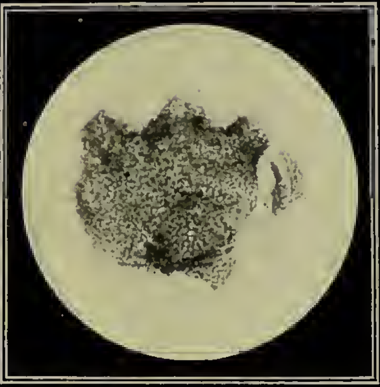


FIG. 279. X 100.

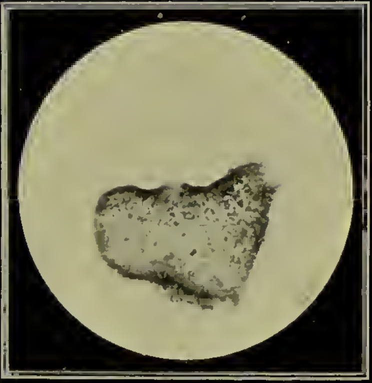


FIG. 280. X 100.

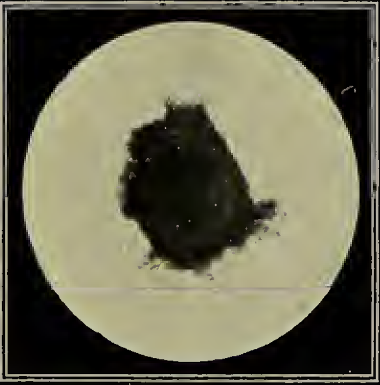


FIG. 281. X 100.

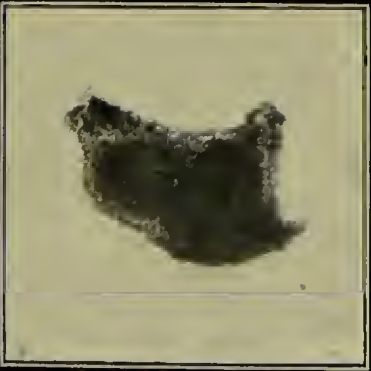


FIG. 282. X 100.

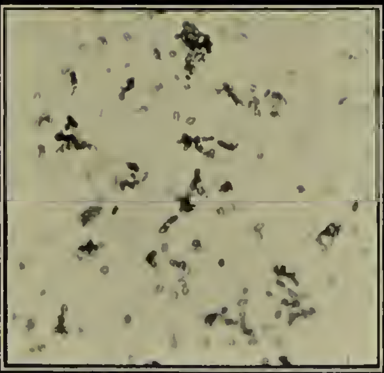


FIG. 283. X 200.

G. H. Robinson, Photo-micro.

PHYLLOSTICTA PRUNICOLA.

PLATE XLVIII.

Clasterosporium carpophilum.

Fig.

284 and 285. Sections through part of large black patch on peach fruit (see coloured Plate VIII.), showing conidia produced on surface (× 100).

286. Portion of similar section, showing conidia produced at apex of conidiophores (× 200).

287. Types of conidia from peach leaf (× 200).

288. Conidiophores and conidia from almond leaf (× 200).

289. Patch of the fungus taken from same leaf as Fig. 288, after three days in moist chamber. The conidia at base were formed on the leaf under natural conditions, while arising from the tuft are long filaments with attached conidia in various stages, produced in the moist chamber. It will be observed that the conidia produced under artificial conditions are more elongated relatively to their breadth than those occurring on the leaf under natural conditions (× 100). N.B.—The leaf had been dried and preserved in the herbarium for three months before placing in the moist chamber.

PLATE XLVIII.

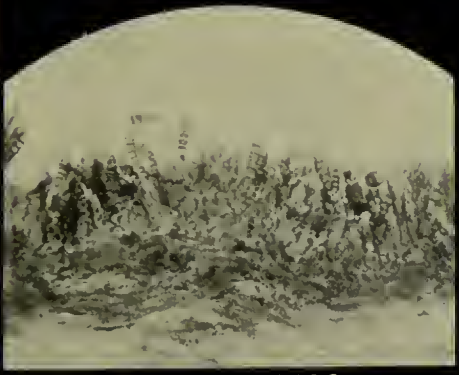


FIG. 284. X 100.

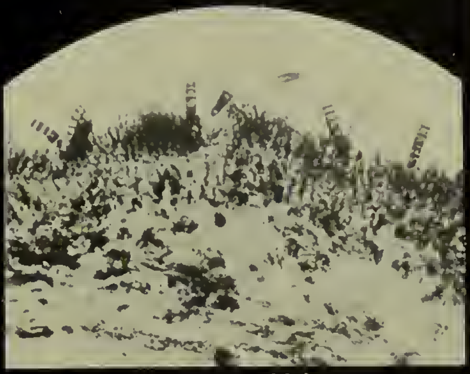


FIG. 285. X 100.

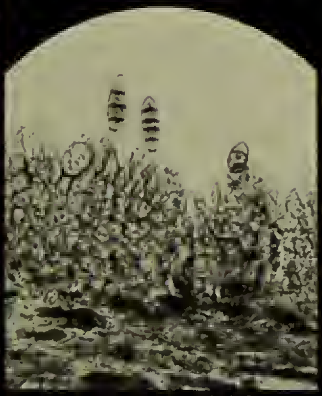


FIG. 286. X 200.

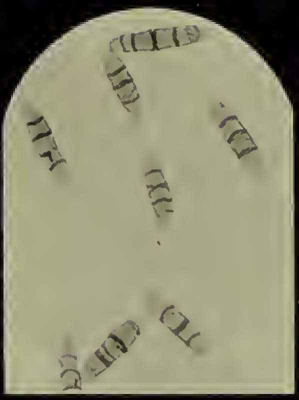


FIG. 287. X 200.

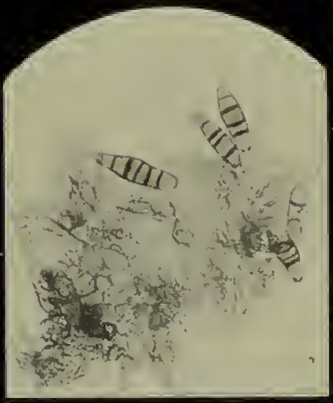


FIG. 288. X 200.

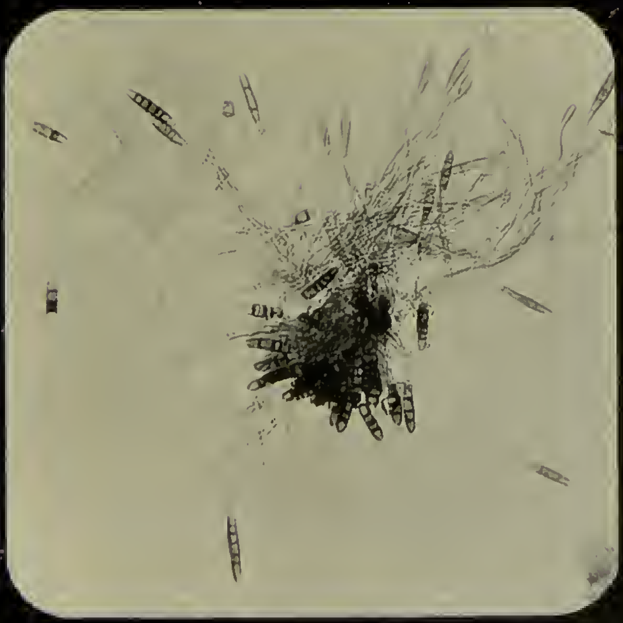


FIG. 289. X 100.

G. H Robinson, Photo-micro.

CLASTEROSPORIUM CARPOPHILUM.

PLATE XLIX.

Clasterosporium carpophilum.

Fig.

290. Growth produced on spots on young leaf of apricot in moist chamber. The leaf was one of the first of the spring, the buds having opened less than three weeks when attacked, and after being kept eight weeks as a dried specimen, was placed in moist chamber, when the additional growth shown took place in four days (× 100).

291. Tubercular structure from spot on almond leaf, which after four days in moist chamber was producing numbers of conidia (× 100). These tubercular structures are not uncommon on leaves of almond, and though occasionally present on the apricot, do not attain such full development.

292. Patch from almond leaf after four days in moist chamber. Naturally formed conidia at base, fertile branching hyphæ ascending from the tuft bearing conidia (× 100).

293. Branching conidiophore and conidia from tuft on apricot leaf three days in moist chamber (× 200).

294. Conidiophores and conidia from tuft on peach leaf, six days in moist chamber (× 200).

PLATE XLIX.

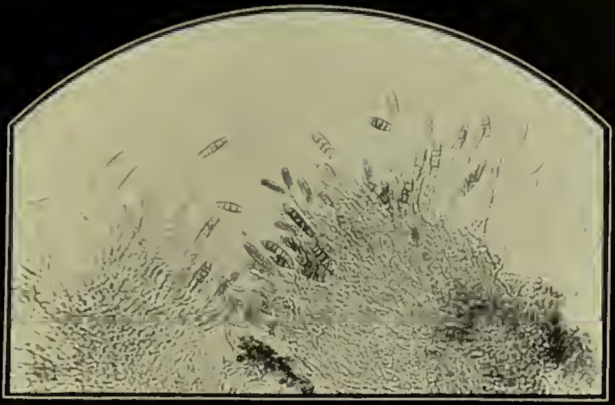


FIG. 290. X 100.

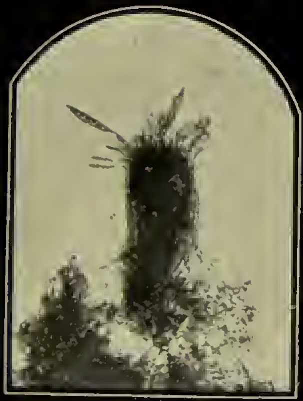


FIG. 291. X 100.

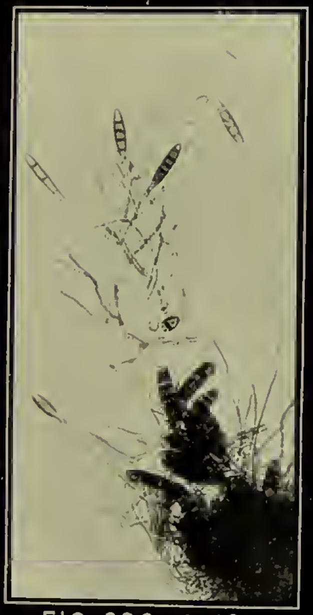


FIG. 292. X 100.

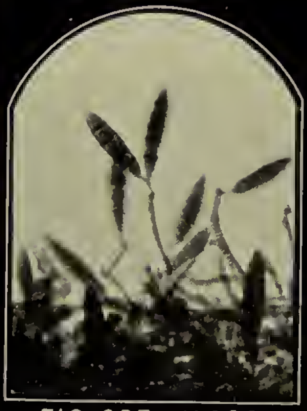


FIG. 293. X 200.

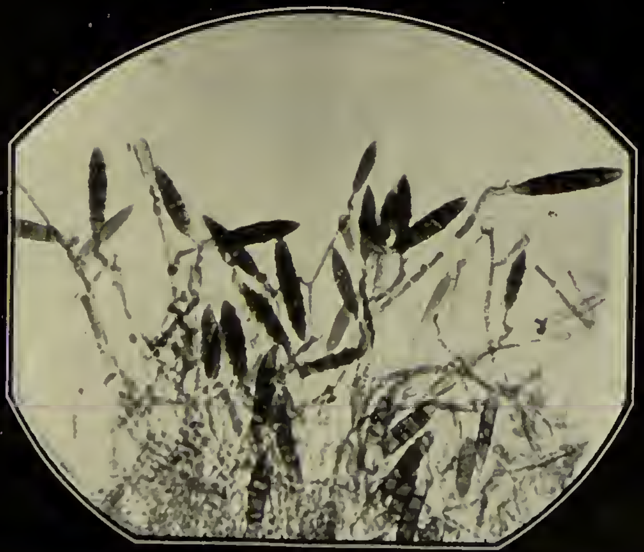


FIG. 294. X 200.

G. H. ROBINSON, Photo-micro.

CLASTEROSPORIUM CARPOPHILUM.

PLATE L.

Clasterosporium carpophilum.

Fig.

295. Fertile hypha giving rise to conidiophores, with attached conidia, showing considerable constriction at septa. From tufts on peach leaf kept in moist chamber for three days (× 200).

296. Portion of tuft from peach leaf in moist chamber four days, showing abnormally narrow conidium and elongated sterile threads (× 200).

297. Portion of tuft from peach leaf 24 hours in moist chamber, with conidiophores and conidia (× 200).

298. Normal and abnormal conidia naturally produced on peach leaf (× 200).

299. Portion of tuft from spot on peach leaf, showing elongation of sterile threads caused through keeping in moist chamber 24 hours (× 200).

300. Portion of tuft embedded in gum of peach shoot, showing the elongated threads and conidiophores arising under natural conditions (× 200).

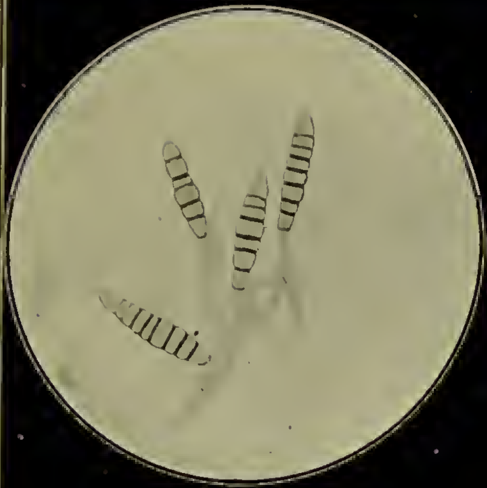


FIG. 295. X 200.

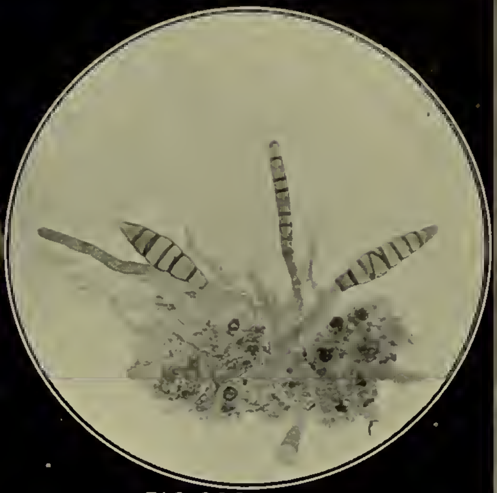


FIG. 296. X 200.

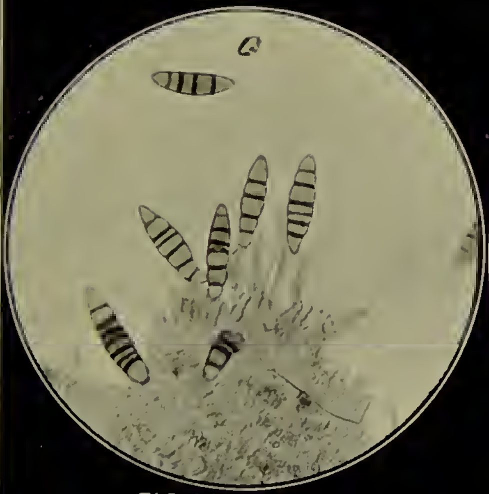


FIG. 297. X 200.

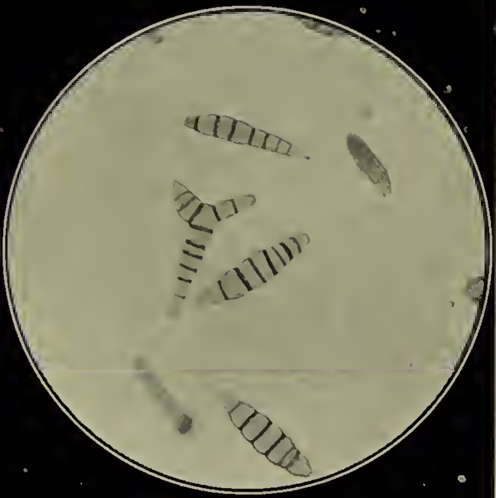


FIG. 298. X 200.

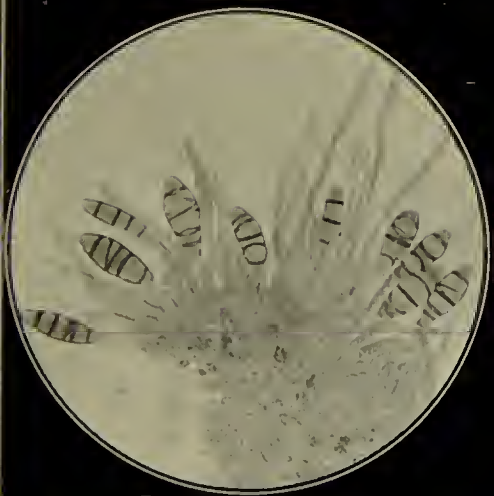


FIG. 299. X 200.

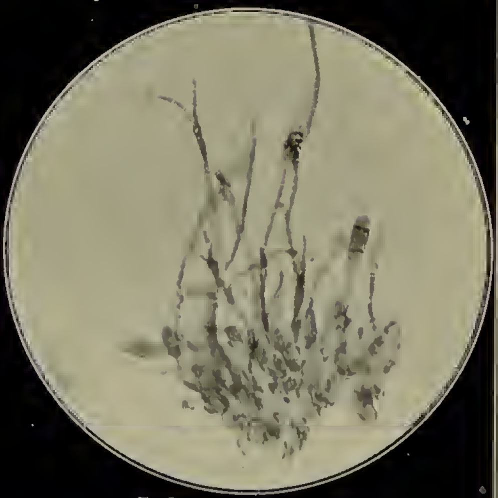


FIG. 300. X 200.

G. H. ROBINSON, Photo-micro.

CLASTEROSPORIUM CARPOPHILUM.

PLATE LI.

Clasterosporium carpophilum.

Fig.

301, 302. Conidia embedded in gum of diseased peach shoot of five weeks' growth, and producing abbreviated conidiophores and secondary conidia both terminally and laterally. Observations point to the conclusion that in this manner tufts of considerable size may be formed deriving nutriment from the gum in which they are embedded, and possessing little, if any, vegetative mycelium strictly so called. (Stained with eosin.) Occasionally the formation of secondary conidia has been met with upon leaves (× 200).

303. Normal germination of conidium embedded in gum of peach twig (× 200). (Stained with eosin.)

Dematium pullulans.

304, 305. Brown thick-walled cells, budding in gum of diseased peach shoot (× 200).

Plate LI.

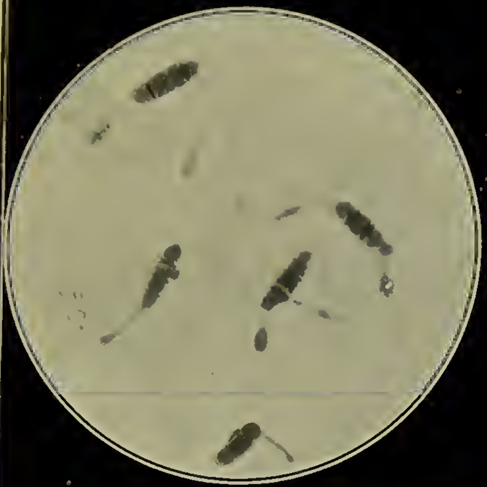


FIG.301. X 200.

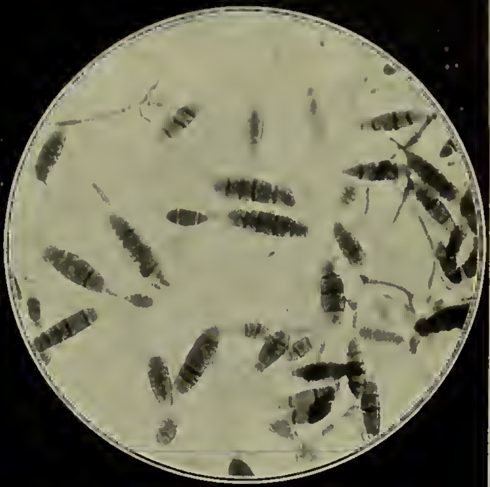


FIG.302. X 200.

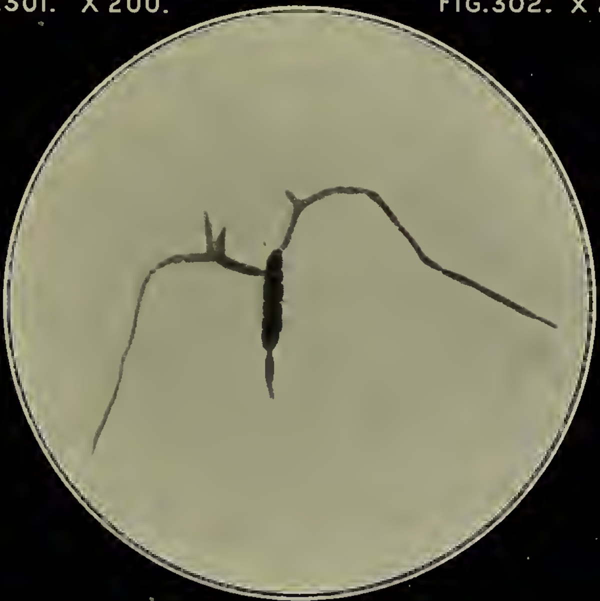


FIG.303. X 200.

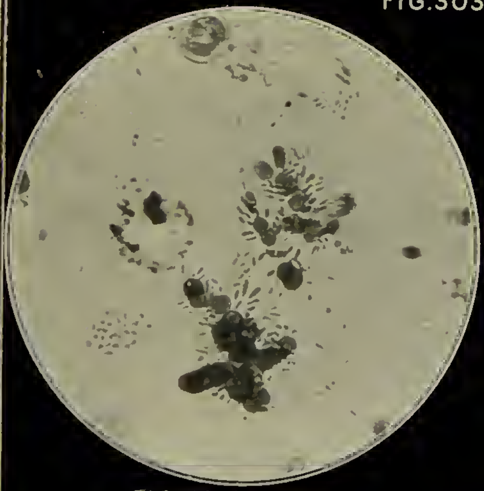


FIG.304. X 200.

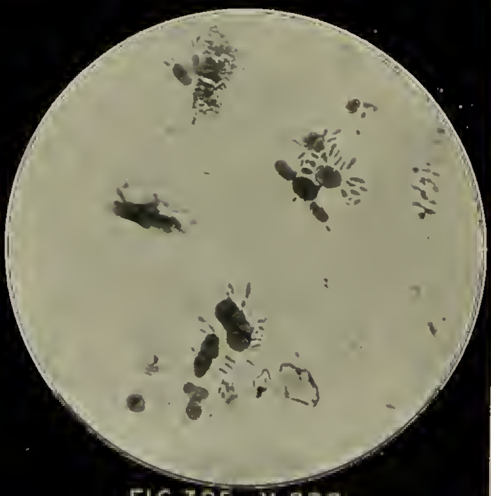


FIG.305. X 200.

G. H. Robinson, Photo-micro.

Figs. 301, 302, 303, Clasterosporium Carpophilum.
Figs. 304, 305, Dematium pullulans.

PLATE LII.

Puccinia pruni.

Fig.

306. Section of peach fruit (Plate VIII.), showing three spore beds of rust deeply embedded in the tissue (× 25).

307. Part of same section showing spores produced within the tissue of the fruit. This spore bed is the one on the extreme right of previous figure (× 100).

308. Section of peach leaf showing uredospore sorus on under surface (× 50).

309. Uredo- and teleuto-spores from sorus on leaf of plum (× 200).

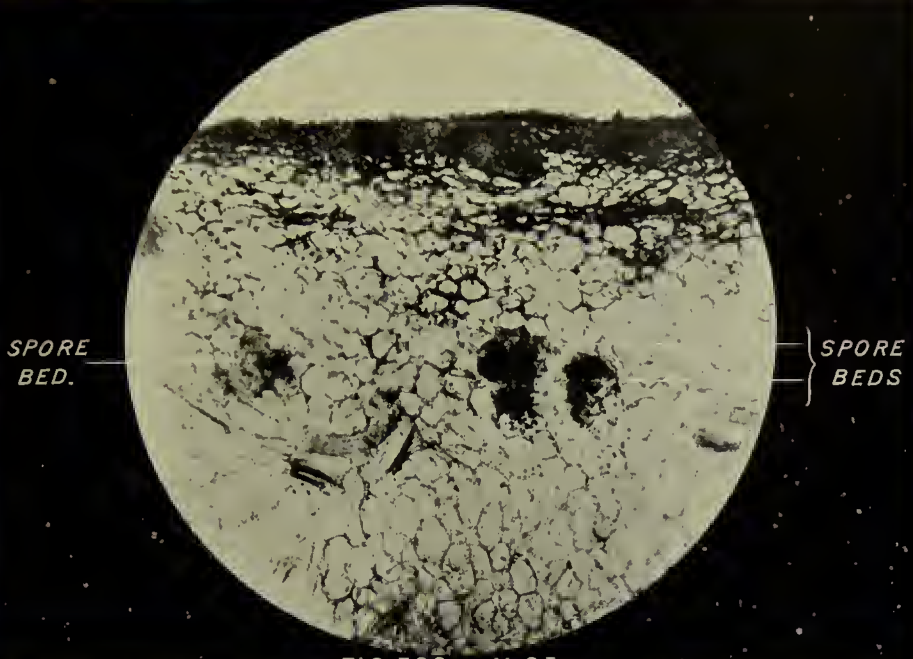


FIG. 306. X 25.

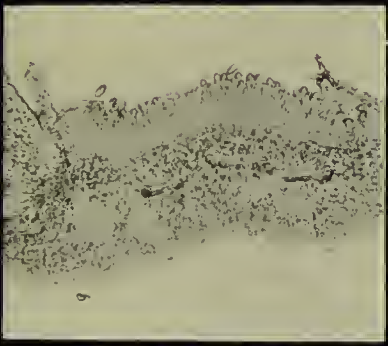


FIG. 308. X 50.

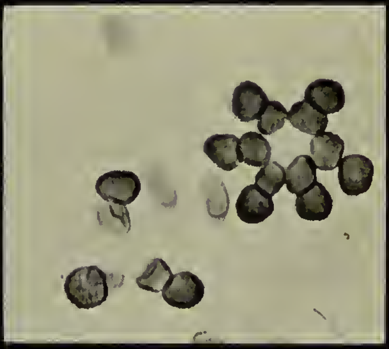


FIG. 309. X 200.

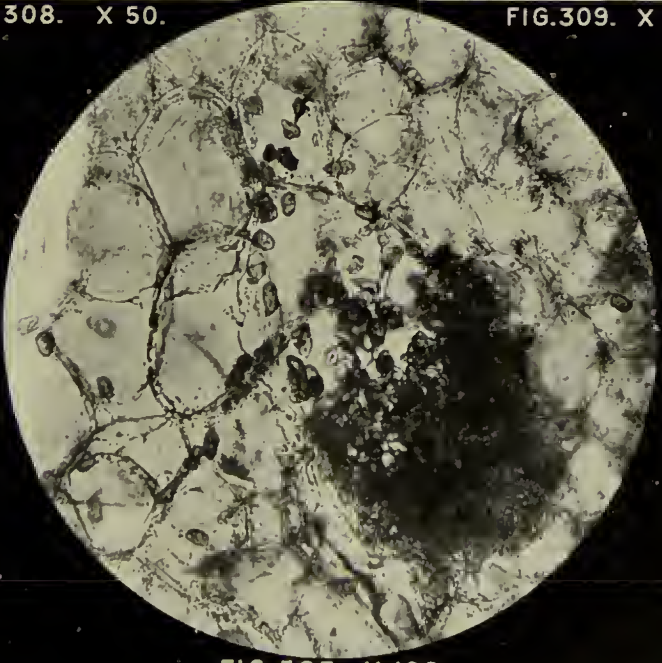


FIG. 307. X 100.

G. H. ROBINSON, Photo-micro

PUCCINIA PRUNI.

PLATE LIII.

Exoascus deformans.

Fig.

310. Section of "curled" leaf of peach, showing asci densely crowded on upper surface (× 50).

311. Part of similar section, showing asci and spores on surface of leaf (× 200). (Stained carbol-fuchsin.)

Cytospora leucostoma.

312. Section through twig of peach, showing the many chambered perithecium of the fungus (× 65).

Pyrenochæta rosella.

313. Perithecium showing erect rigid bristles clustered round the mouth. (× 100).

Plate LIII.

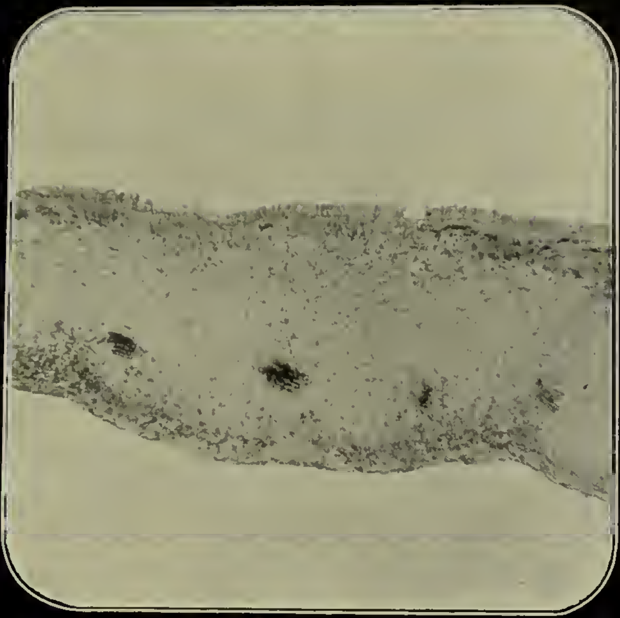


FIG.310. X 50.

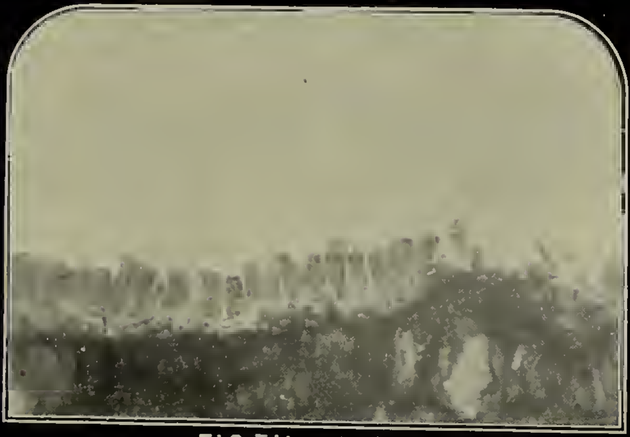


FIG.311. X 200.

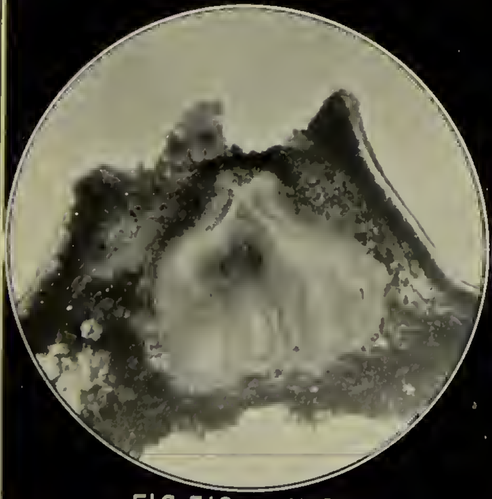


FIG.312. X 65.

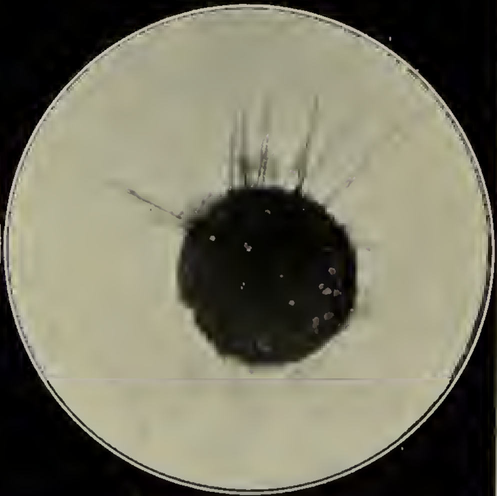


FIG.313. X 100.

G. H. Robinson, Photo-micro.

Figs. 310, 311, Exoascus deformans. Fig. 312, Cytospora leucostoma.
Fig. 313, Pyrenochæta rosella.

PLATE LIV.

Rosellinia aurea.

Fig.
314. Two perithecia, from plum leaf, with bristles at mouth (× 50).

Volutella penicillioides.

315. General view of fungus from apricot leaf. (The black conidia at base have no connexion with the Volutella.) (× 100.)

Phyllosticta persicæ.

316. Portion of spot on apricot leaf, showing perithecia of the fungus in various stages of development (× 50).

Chain Gemmæ, &c.

317. Chain Gemmæ, associated with shot hole on apricot leaf (× 100).

318. Various hyphæ found associated with shot hole on apricot leaf (× 100).

PLATE LIV.

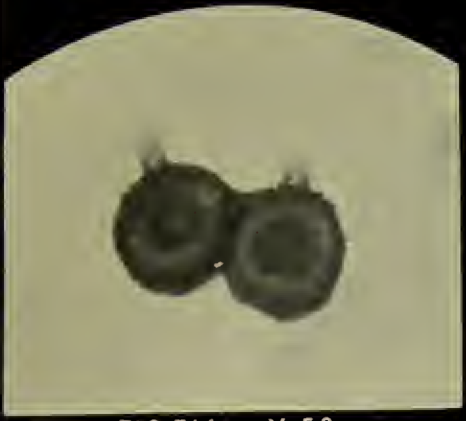


FIG. 314. X 50.

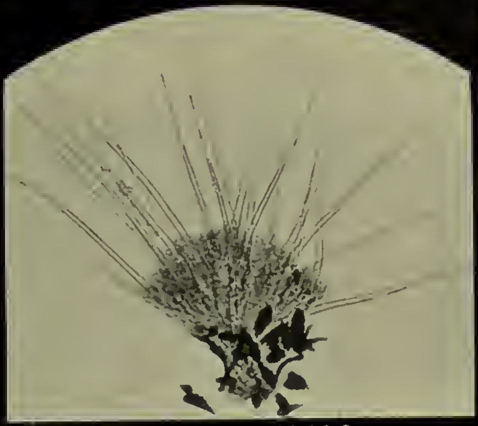


FIG. 315. X 100.

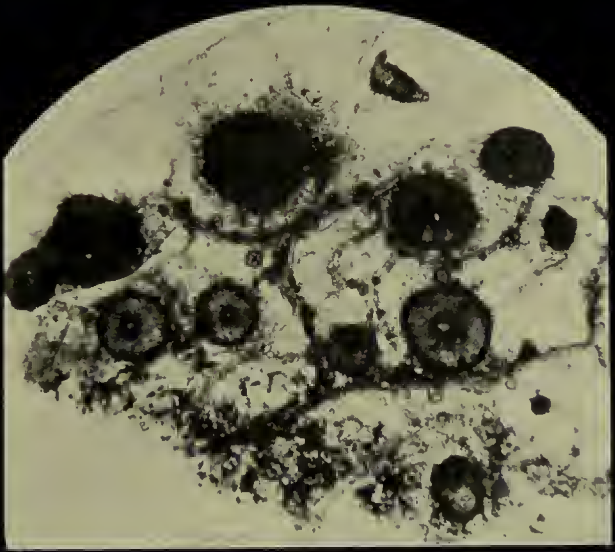


FIG. 316. X 50.

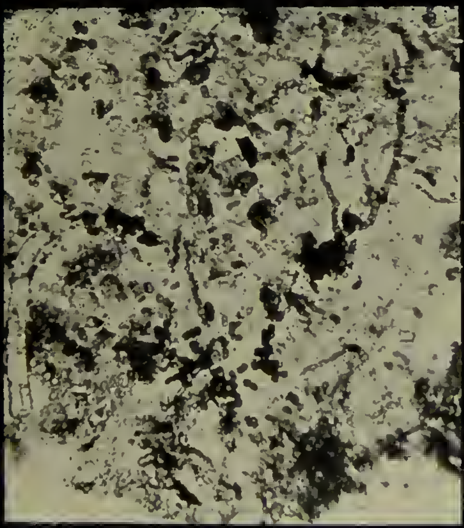


FIG. 317. X 100.

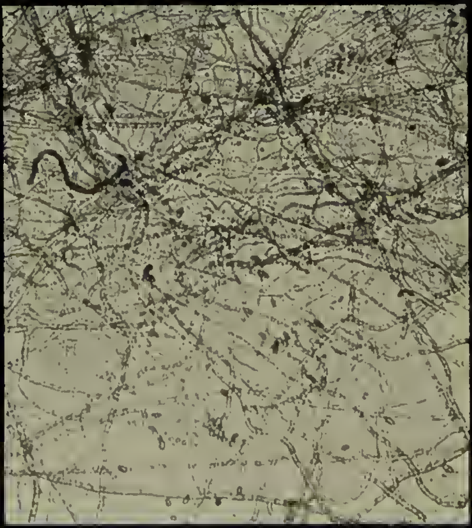


FIG. 318. X 100.

G. H. ROBINSON, Photo-micro.

Fig. 314, ROSELLINIA AUREA. Fig. 315, VOLUTELLA PENICILLIOIDES.
Fig. 316, PHYLLOSTICTA PERSICAE. Fig. 317, CHAIN GEMMÆ.
Fig. 318, HYPHÆ IN "SHOT HOLE."

weather. Leveille, in his original drawings of *Helminthosporium carpophilum*, records these features as existing on the fruit of the peach. (Plate L.)

[In November some ruddy spots on leaves of apple tree, the branches of which were interlaced with those of a peach, were found with *Clasterosporium carpophilum*, the conditions strongly suggesting that it had passed from one tree to the other.]

Dematium pullulans.

This polymorphic and widely distributed fungus has been met with on all the stone-fruit trees grown here, as well as on the vine and apple. Black masses of the fungus were found on almond seeds, and there was no difficulty in recognising the typical form (see Figs. 21, 22, 23); but in the great majority of cases white patches occurred both on leaves and fruit, and these were at first referred to *Aureobasidium vitis*, Viala and Boyer. The examination of numerous specimens, however, from various localities, showed every transition from the colourless and coloured hyphæ to the large brown thick-walled cells germinating and budding. The hyphæ produced the colourless or sometimes pale-yellow conidia both terminally and laterally in a radiating manner, and the detached conidia multiplied by budding just as in Aureobasidium. (See Plates XXIX. and XXX.) The swollen ends of the conidia-bearing hyphæ are arranged either in a dense layer or loosely, and the one characteristic feature of Aureobasidium is the presence of short sterigmata. These were carefully looked for in a large number of microscopic mounts, but, while the conidia often tapered to a point where attached, there was no clear case found of a stalk supporting a conidium.

From the large amount of material that has passed through my hands, I have been able to show a considerable amount of variation in what is undoubtedly one species, and, from the difficulty of deciding between the tapering point of attachment of a conidium and a short sterigma, some confusion may have arisen as to the presence of the latter. It may turn out eventually, on a careful comparison of material from different sources, that *A. vitis*, Viala and Boyer, *E. vitis*, Prill. and Del., *A. vitis* var. *album* Mont., and *A. vitis* var. *tuberculatum*, McAlp., are all but different phases of the polymorphic *D. pullulans.*

This fungus was also found budding in the gum of a diseased peach shoot, where it was associated with *Clasterosporium carpophilum* and other fungi, and recalls the case of gummosis already referred to as being caused in *Prunus japonica* by the same fungus, according to Massee. (Figs. 304, 305.)

Phyllostictas.

There are six species of Phyllosticta recorded here, and it is sometimes very difficult indeed to determine the recognised species, as they approach each other so closely. The spots on which they occur vary considerably in size and colour, the perithecia are also very variable in size, and even the size of the spores on which so much stress is laid is subject to considerable variation. *P. prunicola*, Sacc., with its mature olive-coloured spores is easy of determination, though errors may arise in dealing with immature specimens. *P. persicae*, Sacc., has hyaline spores about the same size, but may well include several of the described species. Thus Dr. Aderhold, of the Imperial Pomological Institute, Proskau, determined *P. beyerincki*, Vuill., on some specimens of apricot sent, while a similar fungus was verified by Prof. Saccardo as *P. persicae*, Sacc. Since the latter was first described in 1878 and the former in 1887, *P. persicae* may well include *P. beyerincki*, Vuill., and *P. circumscissa*, Cooke.

Results in the Moist Chamber.

During summer about 90 per cent. of spotted leaves of apricot and peach from coastal districts of Victoria and Queensland, when placed in the moist chamber and exhibiting no sign of any fungus-fructification, produced in abundance after four or five days the perithecia of *Phyllosticta prunicola*. The remaining 10 per cent. gave *Ascochyta chlorospora*, *Gnomonia circumscissa* and *Dematium pullulans*, though the proportion of the last was higher in the spring.

On the other hand spotted leaves from the drier inland districts never gave rise to *Phyllosticta prunicola*, but almost exclusively *Dematium* in the spring, and *Ascochyta* and *Gnomonia* in the summer and autumn. The moist chamber possesses considerable value in investigating plant diseases, but the results obtained must be regarded as supplementary to the facts observed under natural conditions.

APPENDIX I.

RETURN of Stone Fruit Trees in 1897–8 and 1898–9, and of Fruit gathered during the Seasons 1897–8, 1898–9, and 1899–1900, in Orchards and Gardens growing Fruit for sale.

Description of Fruit.	Number of Trees and Plants.		Quantity Gathered.		
	1897–8.	1898–9.	1899–1900.	1898–9.	1897–8.
			lbs.	lbs.	lbs.
Almonds	18 442	30,205	90,025	67,164	36,506
			cwt.	cwt.	
Apricots	287 464	300,372	70,022	70,433	56,161
Cherries	230,412	241,534	25 042	30 096	35 526
Nectarines	6,018	5,423	1,796	1,643	1,636
Plums	265,894	291 027	51,019	49.788	58,123
Peaches	293 268	311,804	81,395	58 992	45,549

NOTE.—The particulars as to the number of trees were not collected in 1899–1900.

APPENDIX II.

RETURN of Dried Stone Fruits, showing quantity (dry weight) of each kind during Seasons 1898–9 and 1899–1900.

Description of Fruit.	1898–9.	1899–1900.	Increase.
	lbs.	lbs.	lbs.
Apricots	294,286	315,114	20,828
Nectarines	20	140	120
Peaches	66,372	147.102	80,730
Prunes	8 014	12,595	4,581

APPENDIX III.

Same Return for Mildura alone.

Description of Fruit.	1898–9.	1899–1900.
	lbs.	lbs.
Apricots	272,387	270,674
Nectarines	...	140
Peaches	58,243	125 078
Prunes	4 204	8,588

APPENDIX IV.

Dried Stone Fruit.—Return for Five Consecutive Seasons.

Description of Fruit.	1895-6.	1896-7.	1897-8.	1898-9.	1899-1900.
	lbs.	lbs.	lbs.	lbs.	lbs.
Apricots	108,359	135,158	220,757	294,286	315,114
Nectarines	198	...	...	20	140
Peaches	40,763	52,227	39,420	66,372	147,102
Prunes	9,532	7,493	7,851	8,014	12,595

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